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## The Engineer

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### PUBLIC NOTICES

**Foreman of Works Re-**QUIRED by the GOVERNMENT of NIGERIA for the PUBLIC WORKS DEPARTMENT, for two tours, each of not less than 12 and not more than 18 months, with possible extension. Salary £440 per annum, rising to £560 per annum by annual increments of £12. Quarters free of rent and free passages. Liberal leave in England on full salary. Candidates, age 25 to 40, must have had experience in the Sinking of Concrete Cylinders for Bridge Foundations, and of Bridge Building.—Apply at once, by letter, mentioning this paper, and stating age and full particulars of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/10,765. 5637

**Royal Navy.**

APPLICATIONS are INVITED for APPOINTMENTS as INSTRUCTOR LIEUTENANTS in the Royal Navy.

Candidates must be under 30 years of age, have had a University training, and have taken an Honours Degree in Mathematics, Science or Engineering.

Present rates of pay are from £365 per annum on entry to a maximum of £949 per annum as Instructor Commander. Promotion, by selection, to Instructor Captain is also open, with a maximum of £1277 per annum.

Retired pay, to officers over 40 years of age, after 12 years' service, wages from £300 per annum for an Instructor Lieutenant to a maximum of £900 for an Instructor Captain, according to length of service. Service pension is also allowed to officers if invalided before becoming eligible for retired pay.

Service victualling, cabin accommodation, and servant are provided.

In cases where it is not possible to provide these the following allowances are paid in lieu:—

Victualling allowance, £80 per annum.

Lodging allowance, £80 to £100 per annum, according to rank.

Servant allowance, £30 to £60 per annum, according to rank.

For further particulars apply in the first instance to THE SECRETARY OF THE ADMIRALTY, Whitehall, S.W. 1. 5569

**University College of Swansea.**
(A Constituent College of the University of Wales.)

APPLIED SCIENCE DEPARTMENTS.

METALLURGY.

Professor: C. A. EDWARDS, D.Sc. (Manchester).
Lecturer: H. I. COX, M.Sc. (Wales and Birmingham).
Assistant Lecturers: A. L. NORBURY, M.Sc. (Manchester); L. B. PFEIL, A.R.S.M.

ENGINEERING.

Professor: FREDERIC BACON, M.A. (Cantab), A.M. Inst. C.E., M.I. Mech. E., M.I.E.E.
Lecturer in Electrical Engineering: R. G. ISAACS, B.Sc. (Lond.), A.M.I.E.E.
Lecturer in Civil Engineering: J. LLOYD DAVIES, B.Sc. (Lond.).
Demonstrator: J. SELWYN CARWELL.

The College offers a number of exceptional advantages to students who aim at entering upon professional careers in Metallurgy or in Engineering. It is situated in the heart of an industrial area, which includes a large number of works of very varied character, and presents an unrivalled variety of metallurgical practice. The manufacturers of the district who contribute largely to the support of the College give the staff and the students of the Applied Science Departments every access to the works, and the Managers, Engineers and technical officials cooperate with the staff of the College in making visits to works of practical educational value to the students.

COURSES OF STUDY are provided: (1) for the B.Sc. Degree of the University of Wales in (a) Metallurgy, (b) Civil Engineering, (c) Mechanical Engineering, (d) Electrical Engineering; and (2) for Diplomas of the College in (a) Metallurgy, (b) Civil Engineering, (c) Mechanical Engineering, (d) Electrical Engineering.

Persons who are not desirous of studying for Degrees or Diplomas may attend selected College classes, provided that satisfy the authorities of the College that they are qualified to benefit by such classes.

Several Open Entrance Scholarships, each of the annual value of £50, with free tuition, and the South Wales Institute of Engineers' Scholarship in Engineering of the annual value of £70, with free tuition, will be offered for competition in September, 1921.

Particulars concerning admission to the College, and of the Entrance Scholarships, may be obtained from the undersigned.

EDWIN DREW,
Registrar.

University College Offices,
Dumfarton House,
Byrn-y-mor-crescent, Swansea. 5615

**City and Guilds (Engineering)**
COLLEGE.

There are TWO VACANCIES in the MECHANICAL ENGINEERING DEPARTMENT for DEMONSTRATORS in ENGINEERING SCIENCE. Salary £300.—Apply in the first instance to Professor W. E. DALBY, F.R.S., City and Guilds (Engineering) College, Exhibition-road, London, S.W. 7, before July 26th. 5623

**East London College (University of London), Mile End, E. 1.**

REQUIRED, a LECTURER in CIVIL ENGINEERING. Initial salary from £500 to £550, according to qualifications. Particulars on application to the REGISTRAR. 5598

**Ministry of Education, Egypt.**
DEPARTMENT OF TECHNICAL, INDUSTRIAL AND COMMERCIAL EDUCATION, CAIRO.

APPLICATIONS are INVITED for the POST of PRINCIPAL of the SCHOOL OF ENGINEERING, GIZEH (a Higher College), which will be vacant from October 1st next.

High academic and professional qualifications, together with responsible University and Professorial experience, are desired.

The salary proposed is £E1200 to £E1440, with free residence, but the Selection Committee will be prepared to recommend an increase on this for an exceptionally qualified and experienced candidate.

Before making formal application, intending applicants should obtain from G. ELLIOT, Esq., Director, Egyptian Educational Mission, 28, Victoria-street, London, S.W. 1, a copy of the Note, giving further particulars of the position, together with instructions for applying.

July 1st, 1921. 5619

**Tenders Required for 100,000** FIREBRICKS, 9in. by 4½in. by 3in.; sending sample.—Tenders to be received not later than August 6th.—JOHN THOMPSON (Wton), Ltd., Engineering Works, Wolverhampton. 5650

### PUBLIC NOTICES

**The Royal Technical College,**
GLASGOW.

APPLICATIONS are INVITED before August 1st for an ASSISTANT LECTURESHIP in the Department of Civil Engineering. Salary £300 to £350, according to qualifications. Practical experience essential.

Particulars may be obtained from the PROFESSOR of CIVIL ENGINEERING at the College. 5596

**The University of Sheffield.**
FACULTY OF ENGINEERING.

APPLICATIONS are INVITED for the POST of ASSISTANT LECTURER in MECHANICAL ENGINEERING.

Salary £400 per annum, including evening work during Winter Session. Candidates holding a University Degree with Honours in Mechanical Science preferred.

Applications, stating particulars of training and experience, accompanied by three testimonials, should be sent not later than August 20th to the undersigned.

W. M. GIBBONS,
5672 Registrar.

**County Borough of Belfast.**
ELECTRICITY DEPARTMENT.

The Belfast Corporation invite TENDERS for the MANUFACTURE, DELIVERY and ERECTION at the New Harbour Power Station, Belfast, of the following plant:—

Section "M."—ONE 12,500 K.W. TURBO-ALTERNATOR, with Condensing Plant and Auxiliaries.
" "N."—FOUR WATER-TUBE BOILERS, with Superheaters and Forced Draught Fans.
" "O."—FOUR FUEL ECONOMISERS.
" "P."—TWO STEEL CHIMNEYS, with FOUR Electrically Driven SUCTION DRAUGHT FANS.
" "Q."—ONE Electrically Driven CENTRIFUGAL PUMP, capacity 18,000 g.p.m.

Specifications and other particulars may be obtained on application either to Messrs. Preece, Cardew and Rider, 8, Queen Anne's-gate, Westminster, S.W. 1, or to Mr. T. W. Bloxam, City Electrical Engineer, Belfast.

Tenders, upon the printed forms and sealed in envelopes endorsed "Tenders for Plant, New Harbour Power Station," must be lodged in the Town Clerk's Office, City Hall, Belfast, not later than 10 a.m. on Monday, the 22nd August, 1921.

The lowest or any Tender will not necessarily be accepted.

An official receipt must be obtained for every Tender delivered by hand. Tenders sent by post must be registered.

R. MEYER,
5621 Town Clerk.

**Ely Urban District Council.**
WATER SUPPLY EXTENSION.

The Ely (Cambs) Urban District Council invite TENDERS for the SUPPLY and DELIVERY of about 4½ Miles of 4in. and 3in. CAST IRON SOCKET PIPES (Class B, British Standard Specification), together with BENDS and SPECIALS.

Specification and form of Tender may be obtained from L. E. Wilson, Civil Engineer, Middlesex House, Bilneo-grove, Cambridge.

Tenders, endorsed "Cast Iron Pipes," to be sent to me, the undersigned, not later than 10 a.m., 8th August, 1921.

The Council do not bind themselves to accept the lowest or any Tender.

A. K. CAMPBELL,
Clerk to the above Council.

Market-square,
Ely, Cambs, 18th July 1921. 5638

### PUBLIC NOTICES

**County Borough of Croydon.**
TO STEEL MANUFACTURERS AND CONTRACTORS.

NOTICE IS HEREBY GIVEN that the Council are prepared to receive TENDERS for the SUPPLY and DELIVERY to Russell Hill Reservoir, Woodmansterne-road, South Croydon, of about 214 Tons of STRUCTURAL STEELWORK. Specification, conditions and form of Tender may be obtained on application at the Borough Engineer's Office, Town Hall, Croydon, upon payment of a deposit of One Guinea, which will be returned upon receipt of a bona fide Tender.

Tenders on the prescribed form to be sent to me by Eleven o'clock in the forenoon of Tuesday, the 16th day of August, 1921, endorsed "Tender for Steelwork, Russell Hill Reservoir."

Tenders will only be received subject to the terms of the draft contract deposited at my office, and which may be inspected during office hours.

The Council will not be bound to accept the lowest or any Tender.

JOHN M. NEWNHAM,
Town Clerk.

Town Hall, Croydon,
15th July, 1921. 5634

**Metropolitan Water Board.**
TENDERS FOR THE SUPPLY AND ERECTION OF SEMI-DIESEL ENGINES, CENTRIFUGAL PUMPS AND SHAFTING AT BARN ELMS, BARNES, SURREY.

The Metropolitan Water Board invite Tenders for the SUPPLY and ERECTION of FOUR SEMI-DIESEL ENGINES, each of approximately 25 B.H.P., and FOUR CENTRIFUGAL PUMPS, SHAFTING, PULLEYS, &c., at their Barn Elms Works, Barnes, Surrey.

Forms of Tender, conditions of contract, specification and drawing may be inspected without payment of fee at the offices of the Board, Engineer's Department (Room 182), 173, Rosebery-avenue, Clerkenwell, E.C. 1, on and after Tuesday, 2nd August, 1921. Contractors desirous of tendering may obtain the necessary documents from Mr. Henry E. Stilgoe, M. Inst. C.E., the Chief Engineer, on production of an official receipt for the sum of £1 1s., which sum must be deposited with the Board's Accountant, and will be returned on receipt of a bona fide tender, together with all incidental papers. Such payments and applications must be made between the hours of 10 a.m. and 4 p.m. (Saturdays 10 a.m. and 12 noon), Thursdays excepted.

Tenders, enclosed in sealed envelopes, addressed to "The Clerk and Solicitor, Metropolitan Water Board, 173, Rosebery-avenue, E.C. 1," and endorsed "Tender for Machinery, Barn Elms," must be delivered at the offices of the Board not later than 10 a.m. on Wednesday, 21st September, 1921.

The Board do not bind themselves to accept the lowest or any Tender.

W. MOON,
Clerk and Solicitor.

Offices of the Board,
173, Rosebery-avenue, E.C. 1,
18th July, 1921. 5652

**Severalls Mental Hospital, Colchester.**

FOR SALE, FOR IMMEDIATE DISPOSAL, ONE 100 K.W. COMBINED GENERATING SET, 400 Volts D.C. The engine is Double-acting Compound, by Messrs. Davy, Paxman, Ltd. The Generator is Compound-wound, by the British Thomson-Houston Co. The set is combined on one base plate, and is in good working order and can be seen running on load up to July 31st, 1921. The engine and generator were erected new in 1912, and the only reason for sale is that room is required for oil-driven plant.

For form of Tender and fuller particulars, apply to the CLERK OF THE HOSPITAL. 5649

### PUBLIC NOTICES

THE COMPANIES (CONSOLIDATION) ACT, 1908.
NOTICE TO CREDITORS.

**The Railless Electric Traction Co., Ltd.**

NOTICE IS HEREBY GIVEN that the CREDITORS of the above-named Company are REQUIRED, on or before the 31st day of July, 1921, to SEND their NAMES and ADDRESSES and the PARTICULARS of their DEBTS or CLAIMS, and the NAMES and ADDRESSES of their SOLICITORS (if any) to ALFRED PAGE, Chartered Accountant, of 23, Kingstreet, Cheapside, London, E.C. 2, the Liquidator of the said Company, and if so required by notice in writing from the said Liquidator, are by their Solicitors, or personally to come in, and prove their said debts or claims, at such time and place, as shall be specified in such notice, or in default thereof, they will be excluded from the benefit of any distribution made before such debts are proved.

Dated this 16th day of July, 1921.

ALFRED PAGE,
5650 Liquidator.

PATENTS AND DESIGNS ACTS, 1907-1919.

**Notice is Hereby Given that** FREDERICK HENDRIK DE BRUINE, Artillery Officer, of Bandoeng, Java, Netherlands East Indies, SEEKS LEAVE to AMEND the SPECIFICATION for LETTERS PATENT No. 161,352, entitled "A New Method of Obtaining the Artillery Data for Firing at a Rapidly Moving Object, and Apparatus therefor."

Particulars of the proposed amendment were set forth in the Illustrated Official Journal (Patents), issued on the 13th July, 1921.

Any person, or persons, may give notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.

W. TEMPLE FRANKS,
5640 Comptroller-General.

**The South Indian Railway Company,** Limited, are prepared to receive TENDERS for the SUPPLY of:—

ROOFING, STANCHIONS, GIRDERS, &c. (required for new Carriage and Wagon Shops).

Specifications and forms of Tender may be obtained at the Company's offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Roofing, &c.," must be left with the undersigned not later than 2 p.m. on Wednesday, the 3rd August, 1921.

A charge, which will not be returned, will be made of 20s. for each copy of the specification.

Copies of the drawings may be obtained at the office of Messrs. Robert White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France,
London, S.W. 1,
20th July, 1921. 5602

**The Great Indian Peninsula Railway Company.**

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely:—

| Nos. | | Specification fees. |
|---|---|---|
| 1. | SPARK ARRESTERS and SIEVES | 2s. 6d. |
| 2. | DRAWN BRASS ANGLES, &c. | 7s. 6d. |

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes, sealed and addressed to the undersigned, marked "Tender for Spark Arresters and Sieves," or as the case may be, not later than Eleven o'clock a.m., on Tuesday, the 9th August, 1921.

The Directors do not bind themselves to accept the lowest or any Tender.

R. H. WALPOLE,
Secretary.

Company's Offices,
48, Copthall-avenue, E.C. 2,
London, 21st July, 1921. 5624

**The Warneford Hospital Require** the SERVICES of a competent ENGINEER to Take Charge of Boilers, Heating and Laundry Appliances. Applications, enclosing copies of references and stating wages required, should be forwarded to the undersigned.

HOUSE GOVERNOR,
Warneford Hospital,
5677 Leamington.

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## PUBLIC NOTICES

**Bombay, Baroda, and Central INDIA RAILWAY.**

**TWO ASSISTANT ENGINEERS.**

The Directors are prepared to receive APPLICATIONS (BY LETTER ONLY) from duly-qualified candidates for APPOINTMENT on the above Railway in the Way and Works Department. Candidates must be active, of good physique, with a thorough knowledge of Instrument Work and well trained in ordinary Engineering Knowledge. They must have been trained in a recognised Engineering College, and have passed the Associate Membership Examination of the Institution of Civil Engineers or hold an Exempting Degree. Preference will be given to those who have had practical experience of not less than a year with a British or Colonial Railway on construction or open line maintenance, or with the Royal Engineers on Field Service.

TERMS.—Three years' agreement in the first instance, with a salary commencing at Rs. 550 to Rs. 700, according to age and qualifications, and rising according to the Company's rules. First-class free passage to India (salary commences from date of sailing for India) and home again on termination of services.

AGE.—Must not exceed 28 years.

Applicants must give a full record of their career in chronological order, with dates, giving details of their general and technical education (training and subsequent experience), with COPIES ONLY of any testimonials, certificates, &c., on which they may have in their possession. Details of service with H.M. Forces should be given.

Full particulars, stating age, whether married or single, &c., as set out above, should be sent to the undersigned not later than 6th August, 1921.

Officers who have suffered disablement through wounds, provided their disability will not interfere with the proper performance of their duties, will be eligible, but selected candidates will only be finally appointed subject to their passing a strict medical examination by the Company's Consulting Physician.

S. C. S. YOUNG,
Secretary.

Offices: The White Mansion,
91, Petty France (late York-street),
Westminster, S.W. 1. 5481

**South Staffordshire Water-WORKS COMPANY**

**CIVIL ENGINEERING ASSISTANT.**

The above Company REQUIRE AT ONCE the SERVICES of a CIVIL ENGINEERING ASSISTANT, about 30 years of age, with technical and practical training and conversant with the work of large Waterworks Undertakings. Preference will be given to applicants who are good draughtsmen with experience of parliamentary work and who have had actual experience of Main Laying, Reservoir Construction, Sinking of Large Bore-holes, are competent Surveyors and Levellers.

Applicants should be associate members of the Institution of Civil Engineers.

Salary £350 to £450, according to qualifications.

Applications, giving full details of experience, and enclosing copies of recent testimonials, must be addressed to the undersigned.

FRED. J. DIXON, M. Inst. C.E.,
Engineer-in-Chief.
28a, Paradise-street, Birmingham. 5651

**Junior Technical Assistant**

REQUIRED in Physics and Instruments Experimental Department at Farnborough. Candidates should be up to the standard required for Hons. Degree in Physics or Engineering Science, and have experience in Scientific Instrument Design, Development and Construction. Should be willing to fly (as passenger), and must be medically fit for such. Salary, £175-£15-£295, plus Civil Service bonus, amounting probably to about £340 inclusive. Post is pensionable under the Federated Universities' Superannuation Scheme.—Applications, marked "Instruments," will be considered only from ex-Service men, and should be sent to the SECRETARY, Joint Substitution Board, Montagu House, Whitehall, S.W. 1, not later than the 30th July, giving full statement of qualifications and experience. Only those candidates whose qualifications appear prima facie suitable will be interviewed. 5617

**Technical Assistant, Grade 1,**

REQUIRED in Aerodynamics Experimental Department at Farnborough. Candidates should be up to the standard required for a 2nd Class Hons. Degree in Engineering Science, should have experience in Aerodynamic Experimental Work and in an Engineering Workshop. Should be willing to fly (as passenger) and medically fit for such. Salary, £250-£10-£450, plus Civil Service bonus, amounting probably to about £575 inclusive. Post is pensionable under the Federated Universities Superannuation Scheme.—Applications, marked "Aerodynamics," will be considered only from ex-Service men, and should be sent to the SECRETARY, Joint Substitution Board, Montagu House, Whitehall, S.W. 1, not later than the 30th July, giving full statement of qualifications and experience. Only those candidates whose qualifications appear prima facie suitable will be interviewed. 5618

## SITUATIONS OPEN

WANTED, First-class SUPERINTENDING ELECTRICAL and MECHANICAL ENGINEER for Collieries in South Wales; must have good experience.—Address, giving copies only of testimonials, salary required, and date able to take up duties, 5564, The Engineer Office. 5564 A

WANTED, ENGINEER, as Works Manager, in Light Forging and Stamping Trade; 100 hands. State qualifications and salary required.—Address, P3696, The Engineer Office. P3696 A

WANTED for Cement Plant, North of England, a FEW CEMENT MILLERS for wet and dry grinding, also burners. Good men only required. Give full particulars, age, experience, &c.—Address, P3642, The Engineer Office. P3642 A

WANTED for Small Engineering Works, a YOUNG MAN who has had Shop and Drawing-office experience, to Train for Position as Works Manager in repetition work. Small salary, but excellent prospects. Should be well educated and a public school man.—Write, stating age, qualifications and experience, to 5680, The Engineer Office. 5680 A

WANTED, WORKS MANAGER for Constructional Steel Work. One possessing extensive experience in all kinds of Constructional Steel Work, Bridges, Steel Pipes, &c. Must have intimate knowledge of costs and production.—Address, stating age, detailed experience, and salary required, 5543, The Engineer Office. 5543 A

ARTESIAN WELL and BORING ENGINEERS, London, have VACANCY for an ENGINEER; sound technical education; knowledge of Boring, Geology, Pumps and Languages useful; experience desirable, but the right type of man essential; excellent prospects.—Address, 5630, The Engineer Office. 5630 A

ASSISTANT ENGINEER WANTED, with Technical and commercial training and potential selling ability; knowledge of Pumping and Mining machinery an advantage; moderate salary, with unlimited scope to man of the necessary initiative and energy. State education, training, experience and salary required.—Address, 5699, The Engineer Office. 5699 A

BOILER-HOUSE ENGINEER, Technical Training, able to Work Out Heat Balances, WANTED by Yorkshire Manufacturing Firm. State age, training, experience, salary.—Address, 5666, The Engineer Office. 5666 A

COMMERCIAL ENGINEER of Proved Ability to Act as GENERAL MANAGER for company employing 1000 hands on Engine Building; Works Management Experience combined with good Technical Knowledge essential. Progressive position with seat on the Board later if successful.—Address, 5614, The Engineer Office. 5614 A

ENGINEER WANTED, Midland Area, to Take Charge of moderate-size works producing high-class Speciality (not mass production); good technical qualifications and Engineering Experience. Age about 30-35. Salary £400 per annum, with prospects. —Address, P3577, The Engineer Office. P3577 A

GOOD OPENING PRESENTS ITSELF as WORKS MANAGER for energetic Mechanic, in small shop engaged on General Class of Light Engineering Work.—Address, P3697, The Engineer Office. P3697 A

KENYA COLONY.—WANTED, ENGINEER for Plantation; good Mechanic and Electrical Experience necessary.—Apply by letter, COWAN, 121, Victoria-street, S.W. 1. 5630 A

ROAD SURVEYOR.—WANTED by the Eastern District Committee of Perth County Council, experienced MAN to Assist Road Surveyor. Salary £200 per annum, with allowance for motor cycle.—Applications, with references and stating age and experience, to be lodged with the JOINT DISTRICT CLERKS, Blairgowrie. 5662 A

SECRETARY-DIRECTOR REQUIRED for Old-established, well-known Limited Company, London, engaged in Manufactures; preference to one with some Engineering Knowledge. Investment £1000. Salary £600 p.a., plus dividends. Quota to solicitors' and accountants' investigation.—Write, Box 450, Sells, 167, Fleet-street, E.C. 4. 5636 A

WORKS MANAGER REQUIRED in the London district, for Light Engineering Shop, employing 40 to 50 hands; retaining fee of £250 per year plus percentage on output.—Address, P3696, The Engineer Office. P3698 A

WORKING ENGINEER WANTED for Institution on South Coast; experience in Maintenance of Lifts, Electric Motors and Lighting, Steam Boiler Plant, Heating and Hot Water Supply Apparatus and Laundry Machinery essential; knowledge of Fitting and Turning required, and able to do own repairs without supervision.—Reply by letter, stating experience, age and salary required, to MUNFORD BAILEY, 22/23, Clerkenwell-close, E.C. 1. P3720 A

WANTED, DRAUGHTSMAN, Accustomed to Coal-handling Plant.—Address, stating age, experience, wages, &c., 5671, The Engineer Office. 5671 A

DRAUGHTSMAN.—CAPABLE DRAUGHTSMAN WANTED, to Take Charge of Designs for High-class Pumping Engines.—Address, with particulars of experience and salary required, 5660, The Engineer Office. 5660 A

JIG and TOOL DRAUGHTSMAN WANTED by Small Marine Engine Repair Works, to Design Jigs and Tools for small Marine Specialty and to eventually organise the production of same.—Address, 5699, The Engineer Office. 5699 A

TWO GOOD DRAUGHTSMEN WANTED AT ONCE, for Lancashire, one used to Ironworks and Steelworks Plant, and the other to Colliery Engineering Work. State age, experience and salary required.—Address, 5648, The Engineer Office. 5648 A

WATER TURBINES.—LEADING DRAUGHTSMAN REQUIRED, thoroughly experienced and qualified to Take Complete Charge of Section dealing with the Design and Arrangement of all Types of Turbine Plant up to 1000 H.P. units. State age, experience and salary required.—Address, P3672, The Engineer Office. P3672 A

WORKING CHIEF DRAUGHTSMAN or LEADING HAND REQUIRED in Structural Steel Office in London; salary £30 per month.—Address, stating experience, age and qualifications, P3715, The Engineer Office. P3715 A

GENERAL FOREMAN WANTED for Small Engineering Works in West London; must be good all-round man with experience of Sheet Metal Work, able to Read Drawings and to Estimate. Good opening for man with initiative and ability to handle men. —Write, stating age, experience and salary required, to 5639, The Engineer Office. 5639 A

WANTED, a FITTER to be Trained as Foreman in a Non-ferrous Mill producing Extruded and Drawn Bars and Tubes; knowledge of Pumps and Die Fitting essential.—Address, 5629, The Engineer Office. 5629 A

WANTED, a Thoroughly Good FITTER and ERECTOR for Traction Engine Repairs in small country shop; must have had previous experience with Steam Engines, and must be non-society; wages £4 per week. Permanent work to suitable man. —Address, 5626, The Engineer Office. 5626 A

## SITUATIONS WANTED

ASSISTANT WORKS MANAGER or ADMINISTRATIVE, 20 years' experience, modern machine practice, general and mass production; capable organiser.—Address, P3685, The Engineer Office. P3685 B

AS WORKS MANAGER.—ADVERTISER, Late foreman of m/c shop, fitting shop and works maintenance; genuine practical experience combined with tact to lead men.—W. M., 65, Santos-road, Wandsworth, S.W. 18. P3687 B

BUYER TO MANUFACTURING ENGINEERS.—MANAGER of Central Purchasing Organisation, varied experience extending over many years, is OPEN to ACCEPT a NEW APPOINTMENT; would undertake installation of central system of buying for associated companies or departmental re-organisation in single-unit works.—Write, Z.Y. 202, c.o. Deacons, Leadenhall-street, E.C. 3. 5663 B

CIVIL ENGINEER, A.M.I.C.E., WANTS POSITION with CONTRACTORS or others. Extensive waterworks and sewerage experience, design and construction estimates, parliamentary work; good organiser of labour or office. Speaks French; age 30. —Address, P3635, The Engineer Office. P3639 B

CIVIL ENGINEER, B.Sc., A.M. Inst. C.E. (42), twenty years at home and abroad, railways, buildings, roads, bridges, workshops, DESIRES EMPLOYMENT at home. Moderate salary with prospects.—Address, P3614, The Engineer Office. P3614 B

DIE CASTING SPECIALIST, with Wide Experience in designing and manufacturing of all classes of dies and production by up-to-date methods in zinc base, alum, &c., SEEKS POSITION, London or provinces.—Address, P3674, The Engineer Office. P3674 B

ENGINEER (31), Educ. Public School and Technical College, served Kitson and Co., Ltd. (locomotives), practical and D.O., 5 years engineer asst. tea gardens, Assam, R.E. officer in war, DESIRES POST, any country, with prospects; speaks Hindustani; tactful labour organiser, Pelican student, good references.—Address, P3692, The Engineer Office. P3692 B

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**For continuation of Small Advertisements see page iii.**

# The Engineering Conferences.

No. IV.*

## THE INSTITUTION OF CIVIL ENGINEERS.

We conclude below our account of the Conference recently held at the Institution of Civil Engineers.

### SECTION III.—MACHINERY.

#### Automatic Machinery.

The influence of automatic and semi-automatic machinery on the skill and resourcefulness of the operator was discussed in a short paper read by Mr. A. H. Hall before Section III. at the morning session of June 30th. The two main features which have had to be considered by the designer are production and flexibility, but the two are not, of course, compatible, and the more completely automatic the machine the greater the difficulty in changing over from the manufacture of one article to another. These developments in design have, it was pointed out, naturally tended to eliminate the need for initiative on the part of the operator of automatic machines, but in the case of other machines the variety of work now possible on some of them provides ample scope for the display of resource on the part of the mechanic. The points laid down by the opener of the debate as those which might be amplified by discussion were:—(1) The degree of skill exhibited by the operator in dealing with different qualities of material, especially the very hard alloy steels; (2) the skill displayed by women in similar conditions and generally; and (3) the effect on the initiative of the mechanic of highly specialised machines, and of the practice in large works of detailing the operations in the office.

The first point made in the discussion was that more initiative and resource would be exhibited by workers if they benefited by improved results. Captain J. E. Mortimer did not think automatic machines were now objected to by the trade unions. It was necessary, however, if they were to give the desired results to have close co-ordination between the office and the workshop. Sir William Ellis did not think that the accurate setting up of the machine was all that was required. Attention must also be given to obtaining material accurate in quality and in hardness, and no expense within reasonable limits was too great to fill those requirements. Another speaker, Mr. F. E. Robinson, said that he had found that some of the best foremen were men who had had experience of automatics. Women had, however, been a somewhat expensive failure when entrusted with the supervision of automatic machinery. Bad quality of material had proved a handicap in many instances, and it would be necessary to have the material supplied on a much more rigid specification than had hitherto been the case. The criticism of girl labour was not accepted by Mr. Acland, who said that his firm had employed girls to set up work on hexagon turret capstan lathes, and that the work had been done extremely well. Mr. Tripp supported the author in his expression of opinion that details of operations must be worked out in the office. This speaker, referring to women workers, said that his experience indicated that they did their best work only if they were kept at one particular operation.

In summing up the discussion, Mr. Hall said that he agreed that women became very expert if kept on a fixed job. With regard to the output of women workers, if a woman could make as good an output as a man on a capstan lathe, for example, the man was only working at half pressure. While he insisted that the work should be detailed in the office, he desired to lay stress on the importance of the office keeping in close touch with the shop. The efficiency of automatic machines was, however, sometimes very low, and in one instance of which he had experience, it was found that a four-spindle automatic drilling machine was only giving about 35 per cent. of the estimated efficiency, owing to the time taken to set up and grind the tools. In that case the work was split up over several machines, and, while costs were about the same, the output was nearly doubled.

#### Mechanical Appliances at Docks.

The paper by Mr. A. Musker, dealing with mechanical appliances and labour in loading and unloading ships' cargoes, would have been more appropriately discussed in the joint meeting of Section V. and Section II., where papers dealing with dock and harbour equipment were presented. Mr. Musker's main point was that much of the equipment at docks was out of date, and that there was a great lack of mechanical appliances which should take the place of manual labour. He did not lay the blame entirely on engineers of port authorities, or on the shoulders of stevedores, shipowners and shipbuilders, but he insisted that there was a want of co-ordination between the different interests which had prevented improvement in loading and unloading equipment being effected. He suggested that engineer representatives of all interests concerned should make a careful study of the problem and prepare schemes for the more economical handling of cargoes in the various docks of the country.

It was admitted by Sir John Aspinall, who opened the discussion, that British docks were by no means well equipped. Liverpool was criticised in this connection, it being stated that along the whole chain of Liverpool docks there was not a single crane by which a ton of goods could be taken out of a ship and put into a wagon or transferred from wagon to ship. The transit sheds were so close to the quay or dock side that there was no room for a crane track between ship and warehouse. The cranes were on the warehouse roofs. The interiors of the sheds and warehouses were also lacking in proper handling appliances. The handling of coal was being done very badly at many British ports. Outside the North-East Coast, a very large tonnage of coal was under normal circumstances shipped for bunkering or export out of 10-ton wagons. It ought to be possible to double the capacity of these wagons. The equipment of the port of Liverpool was also criticised by Mr. Victor Prigg. The most up-to-date appliances for handling general goods had, he thought, been installed at the port of Manchester. Mr. Davis was another critic of Liverpool, where he had found by experience that a cost of handling a consignment of steel plates had been very high. In his own works he had succeeded, by the installation of travelling cranes, in reducing a particular set of handling charges from 8s. to 1s. 1d. per ton. Mr. Scrutton agreed that the old methods of handling were quite inadequate. The hand truck was useless; the hydraulic crane limited in its application; and his own firm had had recourse with satisfactory results to a system of belt conveyors. A point brought out by Mr. Monkhouse was that provision had to be made for the handling of general as well as bulk cargoes. It was extremely probable, he thought, that if British docks and harbours were being rebuilt to-day a very different type of equipment would be installed. He agreed that co-operation was required between shipowners and dock owners, so that handling plant of the right type, both on board ship and on the dock side, might be available.

### SECTION V.—SHIPBUILDING.

#### Cavitation and Propulsive Efficiency.

A note presented by Mr E. R. Mumford dealt with the causes and effects of cavitation as indicated by the results obtained in special tank experiments. Four conditions of cavitation were taken into account:—(1) When the power and thrust transmitted is such as to cause air to be drawn down from the surface; (2) when the reduction of pressure forward of the propeller is sufficient to cause air or other gases absorbed or diffused in the water to be freed and to concentrate in the vicinity of the propeller; (3) when the reduction of pressure at the propeller causes momentary conversion of the adjacent water into vapour; and (4) when the reduction of pressure is sufficient to cause a nearly perfect vacuum.

In practice, condition number 1 was stated by the author to be a very common cause of loss of propulsive efficiency; condition number 2 frequently occurs with vessels of the fast cross-Channel type, torpedo-boat destroyers, and other vessels fitted with screw propellers impressing a high absolute speed of slip on the water acted upon; conditions 3 and 4 cannot exist with any known nominal slip obtained by a ship's propeller if the speed of rotation be uniform, and the propeller is advancing into undisturbed water. Condition number 1 is not easily observed owing to the turbulence of the water surface, but in number 2 condition it has been shown in experiments—of which a brief account was given by Mr. Mumford—that a 25 per cent. increase of slip below the breakdown point involves a loss of about 20 per cent. of propulsive efficiency. In the case of conditions 3 and 4 it seems probable that minute cavities of extremely low internal pressure may be created momentarily, but would not affect propulsive efficiency to an appreciable extent.

The discussion brought out differences of opinion. Mr. S. W. Barnaby could not agree that condition number 1 had anything to do with cavitation. The real point of Mr. Mumford's note on the subject was condition number 2, and ship designers had to deal with the effects arising from it. Mr. J. H. Narbeth agreed that the improvement of the propellers of merchant ships was a particular need. They were generally designed for a vessel in the fully-loaded condition whereas vessels often went in the light condition from port to port. He thought that with geared turbines the speed of revolution of propellers should be increased and the diameter of propellers decreased. Sir Archibald Denny, who followed, referred to the successful use of the stroboscope. This instrument enabled an observer to see what was happening to the propeller, but he—Sir Archibald—would be glad to have suggestions as to how the phenomena which could be observed might be photographed. Mr. J. H. Gill referred to experiments he had carried out with both small and large propellers under varying conditions. These experiments were still in progress, but he could endorse the statement of Mr. Mumford that condition number 1 was more prevalent than was generally imagined. He personally believed that a propeller having an axially increasing pitch and housed in a nozzle-shaped shroud was worth consideration. Satisfactory results had been obtained in experiments with this type of propeller. Mr. Williamson desired to know whether any experiments had been made with propellers having blades set back. He intimated he had obtained some excellent results by this expedient. He could not agree with the suggestion that propeller diameters should be reduced.

Mr. Mumford intimated that he had tried the setting back of the blades, and although no direct gain had been derived from this change in design, it had been found of advantage to put the blade at a greater distance from the stern-post of the ship.

### SECTION VI.—WATERWORKS, SEWERAGE, AND GASWORKS.

#### Straw Filters.

The three papers which were read before Section VI. on Thursday, June 30th, all dealt with sewage disposal. They were "Straw Filters for Sewage Purification," by Messrs. Eric Hannaford Richards and Michael George Weekes; "Activated Sludge," by Mr. John Haworth; and "De-watering Sludge," by Mr. John D. Watson. The first paper described some experiments carried out at the Rothamsted experimental station on the effect of passing a solution of ammonium carbonate through a bed of straw, and the results obtained when treating the urine, cookhouse and ablution shed water from a camp of 300 navvies by passing it through a specially constructed straw bed. The idea, in both cases, was to ascertain whether straw would separate the nitrates from the liquid containing it, and whether the product would form a useful manure. In the case of the camp, too, there was the added aim at producing an innocuous effluent. At the camp, which was at Wainfleet on the Wash, it was found that whereas the total nitrogen in the raw straw was only 0.50 per cent. of the dry matter, the nitrogen content of the straw taken from the bed was 1.62 per cent., and that after storage for six months the percentage had risen to 2.06 per cent. The manure after storage in a heap by the side of the bed for that period was of excellent quality and in good condition for applying to the soil. It had no smell whatever.

In the discussion which followed, it was stated that the idea of using straw for the purification of sewage was not new, since that material had been used at Balmoral twenty-five years ago. It had given trouble. Several speakers doubted whether straw would prove efficacious in any but very small installations, and others questioned whether it would always be available in sufficiently large quantities, especially in abnormal years like the present, when, by reason of the drought, the straws were everywhere short. Reference was also made to the reluctance evinced almost universally to the use of manure produced from human sewage.

#### A New Method of Aeration.

The second and third papers were taken together. In the first, the author, who is the manager of the sewage disposal works at Sheffield, described an activated sludge plant which is in operation at those works, and in which the sewage is circulated, agitated and aerated by means of eighteen paddle wheels arranged on two shafts across the centre of a tank, each shaft being driven by a 20 brake horse-power motor. The tank, it was explained, measured 200ft. long by 76ft. wide, and was divided into eighteen sections by thin division walls, so arranged as to form in grid-iron fashion a continuous channel 3544ft. long. The liquid is, by means of the paddle wheels, continuously circulated round and round the tank, and volumes of strong sewage, up to from 500,000 to 600,000 gallons per day, are satisfactorily dealt with. The author had found that by spreading the sludge produced on papermakers' gauze and applying a slight vacuum to the under surface of the latter, a great reduction in the water content could be obtained very rapidly. Sludges containing from 98 to 99 per cent. of water are reduced to about 75 per cent. content almost immediately. Thin cakes thus produced, the author stated, dried readily in air, and could, in a few days, be pulverised. Two experimental machines for drying the sludge on this principle were briefly described.

#### De-watering Sludge.

Mr. Watson, in his paper, referred to a system of sludge treatment which is in operation at the Birmingham sewage works, and which he described as biological decomposition plus air-drying. The sedimentation tanks are of the old-fashioned rectangular pattern, and in them precipitation of solids is encouraged by regulating the velocity of flow. The tanks yield in the aggregate 300,000 tons per annum. They are freed from sludge once a week, the sludge being pumped into tanks specially reserved for sludge digestion. The capacity of the special tanks, of which there are six, is 28,000,000 gallons, which is equal to a storage of four months, and Mr. Watson states that it should be greater. The sludge as it is pumped into the digesting tank is simultaneously inoculated with some sludge from the ripest digesting tank. The sludge when thoroughly digested floats on the top of the liquid, and if it can be got to the drying beds in that condition, its liquid content is readily absorbed and led to underlying drains, the solid matter being exposed to the air. Several months are generally necessary for thorough drying. During times of coal strike, the dried sludge has been

* No. III. appeared July 15th.

used to supplement slack, and it has been found that, generally, 1 lb. of sludge will evaporate 1 lb. of water, its calorific value being 4120 B.Th.U. according to one analyser and 4893 B.Th.U. according to another.

The discussion was of an interesting character, and was taken part in by many engineers who have given much study to the question of sewage disposal, as well as by several whose names are specially identified with the development of the "activated sludge" method of treatment. Numerous points were touched upon, among them being the question of how best to aerate the sewage; the respective merits of nozzles and diffusers; the choking of diffusers by unfiltered air; the best depth for digesting tanks; the relative nitrogen content of ordinary and activated sludge; the variation in the types of organisms in sludge under different conditions; the comparative rapidity with which sludge parted with the remainder of its water after the first 15 to 20 per cent. had been got rid of; the greater ease with which fully digested sludge parts with its moisture as compared with partially digested sludge; the cost of sludge disposal by different methods; the maximum quantity of sludge per acre which could be spread on land; and the conveying of the sludge, by pumping, through pipes.

### SECTION VII.—ELECTRICITY WORKS AND POWER TRANSMISSION.

Owing, apparently, to an unfortunate error in the programme—a paper on "Battery Locomotives" having been put down for consideration on that day—and to a misunderstanding in respect of time, both the authors who were intended to read papers before Section VII. on Thursday, June 30th, were absent when the meeting began. Both the papers were read by the Secretary of the Section, and Mr. B. Wel bourne arrived in time to hear the best part of the discussion on his paper, entitled "Low Voltage Overhead Distribution," which was dealt with almost exclusively by the speakers. Whether those present came to the meeting with expectations of hearing and discussing the paper on battery locomotives, we do not know, but in any case very little was said about Mr. Woodhouse's paper, dealing with "The Economic Limits of Distribution from Coal-fired Stations." This, in view of the importance of the subject, was very disappointing, especially as the discussion on the other paper showed signs of exhaustion long before the time arrived for the meeting to end. Briefly, Mr. Woodhouse points out that the economic limit of distribution from a central power station is reached when, as an alternative to further extensions of mains, the establishment of one or more additional stations enables energy to be delivered to the consumers at a lower price. The problem turns, therefore, on a consideration of the steps to be taken to supply an area which extends beyond the economic limits of the distribution pressure in use. This problem has presented itself for solution from time to time as electricity supply has developed over wide areas, and the solutions have been as follows:—(1) To supply from one generating station by increasing the output to meet the demands and adding to the original distribution mains a higher pressure system or systems feeding into the general distribution system at a number of points. The general distribution system may or may not be subdivided into independent sections. (2) To supply from two or more generating stations, each feeding a part of the area independently of the others. (3) To supply from two or more generating stations interconnected by a system of high-pressure mains with or without feeding points. The paper states that within certain limits the first solution is without question the most economical and the economies are summarised in detail. It is shown that for an area of 600 square miles one large station may easily show an advantage over four stations each dealing with approximately 150 square miles. Only one speaker made a real attempt to criticise this paper, and it was a matter of regret that Mr. Woodhouse was not there to deal with the points raised. The large stations referred to in the paper are rated at 500,000 kilowatts and a 60 per cent. load factor is assumed. Such stations, the speaker maintained, looked very well on paper, but when it came to designing them considerable difficulties arose. There was, for example, the difficulty of finding accommodation for the storage of coal and sufficient water for condensing purposes. The possibility of obtaining a 60 per cent. load factor was also questioned. The coal stock in these days, it was argued, should be sufficient for at least three months, and when it came to stations of the capacity mentioned the space required to accommodate it was colossal. The speaker referred to the load factors of various large stations already in existence, and pointed out that none of these stations had a load factor anything like as great as 60 per cent.

In Mr. B. Wellbourn's paper on "Low-voltage Overhead Distribution" it is shown that this form of distribution has a special field of its own in the development stage of the electric supply industry in the United Kingdom, and particularly in rural districts, in works, and for colliery distribution. The standard of work, appearance and continuity of supply, the author explains, is much higher here than in many other countries, and it is believed that ultimately the distribution in all our towns, garden cities, and large villages will be done by underground cables. The basis for this belief lies partly in the growing practice of the Post Office of replacing overhead wires by cables even in country villages. One of the points which the author invited those present to discuss was whether in the interests of standardisation of lamps, motors, &c., as well as of voltage regulation, it is possible to arrange for new work to be carried out at a declared pressure of, say, 240 volts to the neutral, and the opinions of the speakers who touched upon this point seemed to be that by placing transformers upon consumers' premises a good deal higher voltage might be used. It was pointed out that a pressure of 500 volts is employed on tramways, and it is very seldom that an accident occurs. Mr. Ll. B. Atkinson, who presided, explained that on the Continent quite high-pressure overhead lines were run on to farms and round and about houses. Farm hands hooked the leads of electric ploughs, &c., on to these overhead conductors without receiving shocks. The author asked in his paper whether anyone had discovered an entirely effective method of preventing lightning getting on to internal wiring. On the whole, however, the opinion of the speakers appeared to be that there is no great difficulty in that direction, as telegraph and telephone wires are also exposed to lightning, and the arresters provided give adequate protection. A case was mentioned, however, of lightning damaging the wiring of a house supplied by means of overhead conductors. A great deal was said about weather-proof cables, which for various reasons were considered unsatisfactory. The protective covering, several speakers explained, has been found to come off and hang down like ladies' garments. The author considered that these cables were an abomination and hoped that they would never be used in this country. One speaker doubted if the covering added a year's life to the wire, and said that a good galvanised wire would last twenty-five years. The great drawback to the use of overhead distribution systems at present, several speakers considered, was the very high cost of the wooden poles, but it was pointed out that the underground system was also expensive on account of the high cost of excavating ground. In referring to the question of the use of guard wires for protecting telegraph and telephone lines, a speaker mentioned that the Post Office engineers were very considerate in this matter, and in some cases they had insulated their own wires. The neutral conductor could also be used as a guard wire.

### SECTION I.—RAILWAYS, ROADS, BRIDGES AND TUNNELS.

#### ROAD SURFACES.

The rather long paper on "Road Vehicles and their relation to Road Surfaces," which was read by R. G. H. Clements before Section I. on Friday, July 1st, suggested investigations into impact from motor truck wheels, at varying speeds, mounted on pneumatic tires, and new and worn solid rubber tires, and also from the springing and unsprung weight.

The layout of an equipment for experimenting in this direction had already been submitted to, and received the favourable consideration of, Sir Henry Maybury. The apparatus could be put down at no large cost, and would be capable of producing scientific records which, intelligently interpreted, could directly influence design in suspension, wheel diameter and wheel tires, the economy in material for vehicle parts, and also design in road crusts and foundation construction. Such a scheme would be less for the deduction of formulas than for securing facts and data of the values for stresses set up under conditions as closely approximating to actual running service as possible. Comparative observations could be made to record changes in stress due to variations in speed, wheel diameter, modifications of springs, and the departure of the running surface from a true plane.

In the discussion, Sir Henry Maybury said that it was of the greatest importance that the impact question in relation to roads should be considered. His Department proposed to follow the United States and get the vehicle designer to work with the road engineer so as to maintain the road and the vehicle at the lowest possible cost. In 1914 the roads of this country cost 18 millions to maintain; last year they cost 52 millions. Colonel Crompton considered that it would not be an expensive business to organise a complete experimental test for impact. Mr. E. L. Leeming urged that the back axle driving of motor vehicles was the real trouble. Preferential taxation should be given to the well-designed vehicle. The taxing authorities had great opportunities to influence design. Mr. A. Dryland said that it was important that the road engineer should know what stresses he had to contend with, and therefore tests should be undertaken.

A paper on "The Advantages of Bituminous Macadam," by Mr. A. Dryland, was then taken. For the purposes of this paper the author included all bituminous matrices used in modern forms of road construction, whether the product of destructive distillation of bituminous coal, such as tar and pitch, the residuals from oils with a bituminous base, or natural bitumens. The chief advantages of bituminous macadam over water-bound macadam arose, he said, from (1) superior cementitious qualities, (2) exclusion of water, (3) resiliency, (4) facility for repairs, (5) economy. He put forward as a general proposition that the life of a well-constructed bituminous road surface might be taken to be at least three times that of a water-bound macadam, that its economy was evident, and that it also had the advantages of cleanliness and lessened tractive resistance.

Discussing the paper, Mr. R. J. Thomas said he considered that the day of water-bound macadam was past. He recommended the use of bitumen mixed with No. 1 tar in a revolving drum under flame. Because it was hot, there was excellent penetration into the slag used for the surfacing. The road that did not corrugate was unknown, and the advantages of bitumen was that its elasticity allowed it to recover from the corrugations. Mr. H. T. Chapman said that resiliency was a most important factor, and it was because of it that concrete surfacing had not secured the success anticipated. There was a great future for bitumen. Mr. Gittings considered that traffic censuses were unsatisfactory, as they did not record the load, which was very variable and often excessive. The fact that traffic could not be diverted over alternative routes ruled out certain types of construction like concrete. He would like to put in a plea for the horse and urge a non-slippory surface. Colonel Crompton entered a protest against pitch and tar being put on the same plane as bitumen. The latter had resilience, but not the other two. Mr. Lindon pointed out some of the disadvantages of bitumen, and Mr. Dawn wanted to know whether it would stand the high temperatures—180 deg. Fah. in the shade—experienced in the Punjab. Tar-dressing had been tried in Lahore. Sir George Scott Moncrieff said that his experience during the war showed the necessity for knowing the nature of the drainage and the subsoil. The worst subsoil to contend with was chalk.

### SECTION II.—HARBOURS, DOCKS, RIVERS AND CANALS.

#### RIVER ENGINEERING.

At the morning session on Friday, July 1st, Section II. of the Conference had four papers before it. The first to be taken was by Mr. C. H. J. Clayton, and was entitled "The Conservancy and Maintenance of Rivers from the Point of View of Land Drainage." Among the points made by the author was that as regarded the possibility of improvement schemes the present conflict between drainage and navigation-cum-milling interests was a matter of serious import, though it was doubtless capable of equitable adjustment supposing the whole of the interests could be brought within the control of a single authority.

The subject of the next paper, which was read by Mr. R. F. Grantham, was "The Effect of Sluices and Barrages on the Discharge of Tidal Rivers." The author submitted that in view of the large schemes which had recently been mooted, the question of silting in the channels of tidal rivers by the establishment of sluices or barrages was of paramount importance and well worthy of further discussion by members of the Institution.

The third paper, which considered "The Relative Advantages of Dredging and Training Walls in Estuaries," was by Mr. H. C. Reid, who summed up what he had to say by remarking that in the majority of cases the problems to be solved in improving an estuary could be dealt with by properly designed dredging plant. The work, he remarked, could proceed in graduated steps, and that method might properly be adopted in the first instance, unless the interest on the capital cost of alternative training works was substantially less than an annual sum representing the interest on the first cost of dredging added to the annual maintenance cost.

In the fourth paper, in discussing "The Utility of Models for Estuarial Experiments," the author, Mr. G. E. W. Cruttwell, described a working model of the river Thames between Teddington and Shoeburyness which he had designed and had constructed when he was called upon to advise the Thames Conservancy on the improvement of the navigable channel across the Leigh Middle Shoals in Sea Reach.

The four papers were discussed together. The speakers nearly all showed a tendency to confine their remarks to details and to particular cases and rivers. The Lincolnshire Ouse, for example, received more than its fair share of attention—a fact which was remarked upon by the chairman. Considerable diversity of opinion was evinced by various engineers as to the best way of treating certain waterways with the object of preventing flooding, and it called forth an excellent speech from a layman who pointed out the difficulty members of Rivers Boards had in coming to decisions as to what course to pursue when engineers themselves were undecided as to what would give the most satisfactory results. There were two points, however, in which there appeared to be substantial agreement. One was that in deciding upon the treatment of rivers consideration must be given to all interests involved, and that no one of them should be given preferential treatment. The other was that no one principle could be applied to all rivers; each case must be considered on its merits.

A not inconsiderable portion of the discussion centred on the areas brought within the jurisdiction of drainage authorities created under the Drainage Act of 1918—a matter which, strictly speaking, is not engineering at all.

An excellent feature of the Session was the calling, by the Chairman, on the distinguished American civil engineer, Mr. John R. Freeman to say a few words. The result was that the meeting was treated to a most

interesting description of certain peculiar attributes possessed by the Yellow River, in China, which Mr. Freeman has recently been investigating on behalf of the Chinese Government.

The time allotted to the Session was exhausted before everyone who desired to do so had spoken and before the authors could be called upon to reply. It was announced, therefore, that the first half-hour of the afternoon session would be given up to allowing them to do so.

### Pile Driving.

In the afternoon Section II. re-assembled for the reading and discussion of two additional papers, namely, "The Use of Inertia Gauges in Pile Driving," by Mr. E. Latham, and "The Bearing Power of Soils," by Mr. A. L. Bell. Mr. Latham's paper was chiefly concerned with a description of the construction and use of a hydrostatic inertia gauge for measuring the "set" of test piles while being driven. The gauge in question consisted in its essentials of a U-tube of which the one limb, of larger bore, served as a water container, while the other, of smaller bore, was a graduated gauge glass having a sensitive, non-return valve at about the middle of its height. The gauge was clamped to the pile with the U-tube lying in a vertical plane and the bend downwards. When the pile received a blow the water in the gauge glass limb tended, by virtue of its inertia, to remain stationary, while the U-tube itself descended with the pile. As a result, the water gathered above the non-return valve, and by the height at which it stood the penetration of the pile per blow was judged. Some difficulty was experienced in attaching the gauge with sufficient rigidity to the pile to prevent relative motion between the two by virtue of the inertia of the gauge as a whole. The gauge ultimately failed by the fracturing of the graduated glass limb. The author pointed out that it was exceedingly difficult to devise a sensitive instrument that would withstand the shock and jar of pile driving and that it was not easy to obtain a suitable fixed point against which to measure the downward movement of the pile. These difficulties had hitherto apparently prevented any serious attempt to design a suitable gauge for pile driving. The inertia gauge described would, he thought, when developed a little more, provide a satisfactory solution to the problem.

### The Bearing Power of Soils.

Mr. Bell's paper was entirely a historical summary of the development of modern theories regarding the bearing power of soils and the pressure and resistance of earth. Coulomb's and Rankine's theories, he said, still dominated British practice. Boussinesq's work, though profound, had exercised little effect. Sir Benjamin Baker in 1881 called attention to the serious divergence between observed facts and the conclusions of the theorists, and directed attention to the need for further investigation. A year later Sir George Darwin described experiments on the pressure of sand which, he held, confirmed Boussinesq's results rather than Rankine's. He argued, however, that the best practical course to pursue was to follow Coulomb's rule and allow a large margin for safety. In the same year Forchheimer confirmed experimentally Coulomb's theory as to the plane of rupture. In 1902 Wilson demonstrated the important influence on the results of experiments exerted by moisture. For dry sand he found good agreement between his results and those indicated by Rankine's formula. In 1911 Professor Cain pointed out that Sir Benjamin Baker on the occasion referred to above had compared observed facts with the results indicated by a theory which neglected both cohesion in the soil and wall friction. In 1915 the author himself published the results of experiments on the shearing of clay, and showed that, if the cohesion were zero, Rankine's formula was in agreement with observed facts. Since 1915 Ackermann, Crosthwaite and others had investigated the subject, while a special committee appointed by the American Society of Civil Engineers was at work endeavouring to codify present practice on the bearing values of soils for foundations.

The discussion of these two papers was taken jointly. It was chiefly distinguished by a lengthy disquisition from an American visitor on the work so far accomplished by the Committee of the American Society of Civil Engineers. All the speakers were agreed as to the necessity for a satisfactory inertia gauge and for a more complete understanding of the pressure and resistance of earth. In this latter connection one speaker urged that a Committee similar to the American should be appointed to deal with British soils.

## SECTION III.—MACHINERY.

### Large-cylinder Internal Combustion Engines.

A subject which might have been more appropriately discussed in Section V.—*i.e.*, that of internal combustion engines with large cylinders—was raised in Section III. by Sir James McKechnie. The possibilities of marine internal combustion installations of much greater power than had hitherto been fitted in the mercantile marine were, he said, receiving attention, and engine designers and builders were being encouraged to prepare designs suitable for the largest and speediest vessels. It was evident, he thought, that when shipbuilding again became normal its activities would be much more largely directed than hitherto to the building of motor ships. The requirements of ordinary commercial vessels were, however, very different from those of warships and comparatively light, fast craft. Moreover, the modern internal combustion engine aimed at a higher mechanical standard than was attained by the steam reciprocating engine of a few years back. As the result of this fact and of the overload capacity of internal combustion machinery it was possible for such engines of the high duty type to run trials at powers far beyond what they could be expected to maintain with reasonable upkeep in mercantile conditions. Disappointment might thus be experienced, and, indeed, had been met with again and again, and Sir James made the criticism that the internal combustion engine had received set-backs in the early days from that cause. The most successful commercial types were, however, now being sold on a moderate rating. In considering the large internal combustion engine installations the electric drive had advocates to whom the success of the turbo-electric American warships had given encouragement. The subdivision of the oil engine generating plant led to greater complications than when a single turbo-generator was employed, but the arrangement nevertheless appeared to be quite practical. Nor did Sir James McKechnie rule out the internal combustion turbine, although he admitted the difficulties of the problem involved.

Mr. Freeman, speaking as a practical marine engineer, pointed out that an oil engine installation occupied more space and gave less power than a corresponding steam installation. The additional weight in a typical ship he had in mind would be about 200 tons, and the speed of the ship would be somewhat less than with a steam engine installation. The cost of repairs would probably be distinctly higher. Mr. J. H. Narbeth said it was one of the great disappointments of Lord Fisher's life that during his last Admiralty appointment the 100,000 horse-power oil engine battleship had not been found possible of realisation. Mr. Narbeth reminded the Conference, however, that eleven years ago the Admiralty carried out experiments with marine oil engines of 500, 1000 and 1500 brake horse-power, and in one of those ships the whole of the auxiliary machinery was operated electrically through Diesel engines. Engineer-Captain Anstey, referring to possible lines of development, was of opinion that designers should abandon the idea of large-powered cylinders and revert to the multiplicity of small cylinders.

## SECTION IV.—MINING AND METALLURGICAL PROCESSES.

### The War and Mineral Supplies.

On Friday, July 1st, Sir Richard Redmayne presided over Section IV. The first paper dealt with was that by Mr. Thomas Crook, on "The Effect of the War on Mineral Supplies." In many countries, the author says, new sources of supply of minerals were developed as the result of the war, some of which are likely to prove permanent, as, for example, coal in Nigeria and the Federated Malay States, manganese ore in the Gold Coast Colony, bauxite in British Guiana, Dalmatia and Istria, and magnesite in Italy. Others, however, such as the tungsten and chromium mines of the United States and some other countries, have already ceased production owing to the partial restoration of normal economic conditions. The world's output of coal dropped from 1,320,000,000 tons in 1913 to 1,130,000,000 tons in 1919, but in 1920 the output reached 1,300,000,000 tons, thus showing signs of a more normal production. The output in Europe decreased and costs of production increased; on the other hand, the United States exports increased from 22 million tons in 1913 to 39¼ million tons in 1920, excluding bunker coal. With regard to petroleum, the output of 55,000,000 tons in 1913 increased to 98,000,000 tons in 1920, and, unlike most war minerals, petrol has continued in ever-increasing demand since the Armistice. The outputs from the United States, Mexico, Egypt and Persia show enormous increases during the period mentioned. The world's output of iron ore shows a decline, the figures being 175,000,000 tons in 1913 and 145,000,000 tons in 1917. Whilst a reduction is recorded in most European countries, as much as 90 per cent. in the case of France, the United States output increased by 21 per cent. Similarly, there was a decline in the output of manganese ore from 2,272,000 tons in 1913 to 1,864,000 tons in 1917. In spite of the cutting off of exports from Russia during the war, the output of manganese ore from 1913 to 1917 averaged about 1.3 per cent. of the iron ore output, and this average was maintained. The output of nickel and chromite showed an increase between 1913 and 1918 from 32,000 to 47,500 tons in the case of the former, and from 116,000 to 270,000 tons in the latter case. Since the war, however, output of both nickel and chromite has dropped considerably, due to excessive war production. Great increases are also recorded with regard to tungsten, from 8000 tons in 1913 to 34,000 tons in 1918, and in vanadium, from 400 tons in 1913 to 1200 tons in 1917, whilst the output of magnesite increased from 595,000 tons in 1913 to 668,000 tons in 1917, and of graphite from 134,000 tons to 213,000 tons in the same period.

The Chairman said there was another aspect of the question and that was the re-distribution of the mineral deposits of the world from the geographical point of view, which was a very marked and important effect of the war. For instance, Germany had been shorn of her most valuable coalfields and iron deposits. With regard to fuel, the lessened production of coal was due to a variety of reasons, among others war-weariness and ill-health, but the reasons which had contributed to this decrease would not obtain on the oilfield, where the labour employed was immeasurably less than in getting coal. The higher thermal value of oil as compared with coal had also to be taken into account when considering figures of output, and there was the added advantage that where oil was used there were no ashes to be disposed of.

Mr. F. Merricks then called attention to the present position regarding minerals, which, he said, was due to the accumulation of large stocks during the war. The materials had, he said, now become a great drug upon the market and seriously affected business men.

Mr. F. W. Harbord, dealing with re-distribution, said that transport difficulties had caused America, which previously obtained ferro-manganese from this country, to start blast-furnaces of her own, with the result that practically the whole of the ore from Brazil went to America, whereas a large part of it previously came here. In view of the ferro-manganese industry in America, which was becoming much more firmly established, he doubted whether we should get Brazilian supplies over here to anything like the extent we had done before the war. He also referred to the supplies of zinc from Australia, which had become very short owing to strikes. The Australian Government had purchased the zinc areas in Australia, and we should have been in a strong position in re-establishing our zinc industry, but in view of the fact that it took 5 tons of coal to make a ton of spelter; until we could get reasonably cheap coal, the production of spelter in this country economically was impossible.

Dr. F. H. Hatch said that the purchase by the British Government of the output of the Broken Hill mines for a considerable period was having a very deleterious effect on home zinc production. However, zinc smelting was vastly more important, and he was afraid the mining industry would have to suffer.

Mr. H. Kilburn Scott said that it seemed to him that the most important effect the war had had upon mineral supplies was, from the economic point of view, the largely increased cost of labour, and it threw on mining engineers a great responsibility in providing some means whereby labour waste might be reduced. If prices were to come down the reduction would be effected not so much by the increased effort of the workmen as by the increased intelligence of, and the better application of that intelligence by, those responsible for the utilisation of labour.

Mr. A. O. Charlton emphasised the importance of nickel steel and its alloys, as applied to various engineering purposes in peace time, and although there were large stocks of nickel to be worked off at present, he could not help thinking that we should see a great demand for nickel and its alloys within the next few years. He believed that at the present time great use was being made of nickel-chrome alloys, and the proximity of the United States to the deposits of Canada would naturally lead one to expect that the chrome industry in the United States would revive.

Mr. Crook, in reply, said that the two ideas, namely, that excessive production during the war explained the present slump, and that waste of labour increased costs, were somewhat opposed to each other. Taking them together, it was seen that what we were faced with was not excessive production, for there was a famine in these materials. The excess of these materials was not due to heavy requirements, but to over demand, which was a different thing. Europe was starving for copper, for example, but could not afford to pay the price demanded by the United States for copper accumulated under such expensive conditions of production.

### Exhaust Steam Turbines.

The next paper was on "The Utilisation of Exhaust Steam in Turbines," by Mr. Maurice Deacon. In it attention is drawn to the enormous development in the use of exhaust and mixed-pressure steam turbines, particularly at collieries. It would, says the author, now be difficult to find a modern colliery of any magnitude without one or more exhaust or mixed-pressure turbines in use. The national economy in fuel which has been effected by the utilisation of exhaust steam cannot be accurately estimated, but many collieries in the United Kingdom are now performing the bulk, and in many cases the whole, of the underground pumping, hauling, and electric lighting through the medium of mixed-pressure turbines. A colliery of average depth—say, 500 yards—and raising from 2000 to 3000 tons of coal per day, will produce enough exhaust steam to develop at least 1000 horse-power, and with the assistance of high-pressure steam when the supply of exhaust steam is insufficient, from 1500 to 2000 electrical horse-power may readily be produced by means of turbines and electric generators at such a colliery. Assuming as a rough estimate that there are 500 such collieries in the kingdom fully equipped with turbines, the total economy in fuel amounts to 2,000,000 tons or more per annum. A diagram showing the general arrangement of a mixed-pressure turbine plant at a colliery under the author's control, from engine to generator, is given, as well as diagrams

showing the construction of the rotor and casing of a mixed-pressure turbine and the construction of an accumulator.* The cost of generating electrical power by exhaust steam is naturally very low, having regard to the fact that the steam would otherwise be wasted. Regarding the exhaust steam as being of no value, the cost of running is confined to labour, repairs, stores and interest on capital and depreciation of plant. Taking the two latter at 20 per cent. on the capital outlay, the cost of production per B.Th.U. with exhaust steam only is approximately 0.20d., and with mixed-pressure consisting of 20 per cent. of high-pressure steam 0.40d. These costs are taken upon present-day values of plant, wages and stores, and with small coal at 20s. per ton, with the plant running ten hours per day. On twenty hours per day instead of ten, on approximately full load, the cost per unit would have been 0.10d. for exhaust steam and 0.20d. for mixed-pressure steam.

The Chairman said that the very large amount of energy in low-pressure steam had not always been fully realised. Two-thirds of the whole energy in the original steam, which Mr. Deacon utilised, was in many cases being daily thrown away; it was thrown away everywhere where non-condensing engines were in use. As to Mr. Deacon's figures of the cost per unit of electricity generated from exhaust steam, namely, 0.2d., he would like to know the number of units generated from exhaust steam per day or per week, or any other period, and also the number of units generated from live steam. Again, was there ever a time when the energy generated from exhaust steam was greater than could be absorbed by the colliery plant? One would naturally suppose that where the power demand in the colliery was big enough it would pay to generate power electrically through the medium of high-pressure turbines, and even to wind electrically; but unless the load factor were a very big one it would be more profitable to draw electrical power from an electrical power station, where small variations would be less marked.

In his reply, Mr. Deacon said his experience had convinced him that where the winding element was a very large one it was more suitable and more economical to employ steam in the winding engines and to utilise the exhaust steam for the electrification of the remainder of the plant.

### STEAM *versus* ELECTRIC WINDING.

The next paper was by Mr. William C. Mountain, entitled "Steam *versus* Electric Winding." Whether it is economical to adopt steam or electric winding depends, says the author, upon so many circumstances that it is impossible to lay down hard-and-fast rules. If the colliery be isolated, so that a supply of electricity cannot be obtained from a public power station, and the colliery be of large capacity, the most economical method is to put down steam winding engines and utilise the exhaust steam in mixed-pressure turbo-generators. If the collieries are of moderate size or are small and there are several under one or more ownerships, then probably electric winding can be economically adopted. At some collieries blast-furnace or coke oven gas is available, which could be used either in gas engines or under boilers. As an example of heavy winding in collieries in Derbyshire, the author mentioned two collieries, typical of the heavy duty in this country, the depths of which are respectively 820 and 900 yards, and the total weight of coal wound per wind 9 tons 6 cwt. Further particulars are given in a table.* The exhaust steam from the winding engines is used in mixed-pressure turbo-generators. Further examples of steam winding engines are given, which show that up-to-date modern steam winders are economical as regards the consumption of steam per shaft horse-power. In utilising exhaust in exhaust steam turbines a kilowatt can be obtained for about 35 lb. of exhaust steam at 16 lb. pressure absolute delivered from the winding engines into the turbines. As to electric winding, which has made very substantial progress, for small collieries there is a future for it if the coal used under the boilers is of any considerable value. In large collieries there is a future for electric winding if the coal used under the boilers exceeds 8s. to 10s. per ton, but this depends entirely upon the relative costs of steam winders with their boilers compared with the electrical equipment. Electric winding cannot be economically applied to collieries for very large outputs where it is necessary to install a generating plant to produce the necessary output for operating the winder, because the horse-power required for winding is so greatly in excess of the horse-power required for driving other machinery, and as it would be necessary to provide a stand-by plant, the costs would be prohibitive. In collieries generally, particularly where electric winding is adopted, colliery owners would be well advised to take their current from the supply companies, assuming it can be obtained at a reasonable price, even if it is slightly in excess of the cost at which they can produce the current themselves, owing to the amount of capital required for the generating plant being so heavy.

In the discussion, Mr. Maurice Deacon said he considered that to put down boilers at a new colliery for the purpose of generating electric current to perform the winding operations was not an economical project, partly because a modern winding engine would perform its work on between 30 lb. and 35 lb. of steam per indicated horse-power, and the amount of saving in steam could not be very great by putting down an electric generating plant. The extra cost—an electric plant would probably cost three times as much as a steam winding plant—interest and repairs would practically counterbalance the remaining steam not accounted for between the consumption in the turbine and the consumption in the winding engine. Cheap power might, however, be obtained in a district where there were blast-furnaces and coke ovens, and in that case electric winding might become much more economical than steam winding.

* We do not reproduce either diagrams or table.—ED. THE E.

### PROTECTIVE METALLIC COATINGS.

The final paper was entitled "The Relative Values of Protective Metallic Coatings for Iron and Steel," by Mr. S. O. Cowper-Coles. The protection of iron and steel from corrosion by means of protective metallic coatings can be divided into two headings, *i.e.*, electro-positive metallic coatings, and electro-negative metallic coatings, and the paper discussed the relative advantages and disadvantages of the first. Zinc can be applied by four methods: (1) dipping in molten zinc; (2) Sherardising; (3) electro-zincing; and (4) spraying. The first method is used for a variety of work and is the only process at present successfully employed for tank work and corrugated sheets. The spangled effect given to hot galvanised sheets, instead of being an advantage from a protective point of view is a drawback, and some engineers now specify that galvanised iron sheets should not be spangled. The spangles are sometimes obtained by the addition of a small quantity of tin, which is not advantageous. If a section is made through a spangle it will be found that the zinc is very much thinner in some parts than others. Sherardising or vapour galvanising consists of placing the iron or steel in zinc dust or powder, a by-product from zinc smelting works, in a closed drum or receptacle and heating for several hours at a temperature of several hundred degrees below that employed for the molten zinc process. Electro-zincing consists of placing the iron or steel to be coated with zinc in tanks containing zinc solution, such as zinc sulphate, connecting the iron or steel to the negative pole of a dynamo and zinc sheet or slab with the positive. In the spraying process molten zinc is sprayed on to the surface by means of air or a reducing or inert gas, and can be applied to iron and steel structure when erected, but the process is very costly and the coating porous. Considering the great importance of the effective protection of iron and steel from corrosion, it is astonishing that more attention has not been given to the matter. If offers a most useful field of investigation, and might well be carried on with the researches now being made in connection with the corrosion of condenser tubes. There being no means at present of determining in a practical manner the thickness of zinc or zinc-coated surfaces, it appears that the first investigation should be to devise a standard workshop test for this purpose and then apply the corrosion and durability tests. An electro-zinced surface might have a film of zinc evenly distributed, whilst a hot galvanised surface might have five times the amount and yet be very unevenly coated; so that a common test without a previous practical test to determine the thickness and even distribution of the zinc coating is of little value. There was practically no discussion.

## SECTION V.—SHIPBUILDING.

### REDUCTION GEARS.

Some of the troubles which have been experienced in connection with marine turbine reduction gears opened up a discussion which brought out several interesting points and indicated the directions in which improvements were to be sought.

A note by Mr. R. J. Walker and Mr. S. S. Cook on "Marine Turbine Reduction Gears," which was presented by the first-named, showed what was the present position. The use of double reduction gearing in British ships is comparatively new, and the total number of gears built and under construction in all countries is now about 220, representing a total shaft horse-power of 1,150,000. It was pointed out that whereas at the present day in vessels of moderate size and power with single reduction gearing, a steam consumption of 11 lb. per shaft horse-power can be obtained with saturated steam and 9 lb. per shaft horse-power with superheat of 200 deg. Fah., these figures are reduced to 10 lb. and 8 lb. with double reduction gearing. The efficiency of double reduction gearing is over 97 per cent. The troubles which have been experienced have been traced with one exception to defective design or material, faulty workmanship, inferior lubrication, or temporary stoppages of oil when running. It was stated by Mr. Walker that the loads adopted are still a long way from the maximum which could be employed if the teeth of the gears were accurately cut. Failure has not, it was insisted, arisen from excessive tooth pressures, but from want of accuracy of the teeth, and no effort should be spared towards improving gear cutting machinery and methods.

The statements of the authors were confirmed by several subsequent speakers. It was stated by Mr. Sykes, who represents manufacturing interests, that he had experience of double reduction gears which had been in service for two years, and when taken out for examination showed not the least sign of wear. The same speaker suggested that by the employment of larger ratios of reduction it might be possible to obtain with single reduction gearing the economies claimed for double reduction gears. Mr. J. H. Narbeth thought that the time had come to consider whether a smaller propeller running at higher speed could not be adopted in conjunction with reduction gearing. Experience with the San Fernando, which was familiar to marine engineers, suggested that the propellers might with advantage be situated further aft. A question was also raised with regard to the consumption of auxiliary machinery, which tended to complicate the results of steam consumption. Unfortunately, the cost of making definite experiments of that character is rather high, and in one case referred to by Sir Henry Oram had cost the Admiralty at pre-war rates as much as £2000. The same point was raised by Mr. Walker in a brief reply to the discussion. In some instances, he said, the steam consumption of the auxiliaries was as high as 30 per cent. of the total and represented a loss which might be avoided. A proposal had been made that chrome nickel steel might be used for the gear pinions, but manufacturers preferred nickel steel on account of its ductility. The question of the addition of the floating frame as used in the Melville McAlpine gears had also been raised, but in British circles it was regarded as a somewhat unnecessary refinement, and experience had shown that equally good results could be obtained with gearing of the rigid type.

Mr. Stanley Cook dealt, among other points, with the possibility of using higher ratios of reduction and dispensing with the use of double reduction gears. He agreed that theoretically there was no limit to the amount of reduction which could be obtained with single gears, but in practice there was a limit and double reduction gearing was to be preferred.

### DIESEL MARINE ENGINES.

Shipowners are now giving close attention to the use of the Diesel oil engine for purposes of marine propulsion. At the present time a maximum power of approximately 4800 brake horse-power, with sixteen cylinders on twin screws, per ship can be obtained with machinery of proved design. Mr. James Richardson, who read a paper entitled "Recent Progress in Large Diesel Engines for the Mercantile Marine," expressed the belief that in the near future the maximum power that can be obtained with marine oil engines would increase. The problem is being vigorously attacked in this country, and the large variety of types now under construction forms a surprising contrast to the apathy of British engineers in this field. Progress is now proceeding by rapid strides. In the year 1913 the gross tonnage of ships built which were to be equipped with oil engine machinery was 60,000 tons, whereas last year there were being built 454,452 tons of Diesel-driven ships. A point brought out by Mr. Richardson was that no less than 96 per cent. of the total number of ships launched last year required less than 5550 indicated horse-power of machinery per ship, and were thus within the scope of the oil engine as far as total horse-power is concerned. The author discussed the rival claims of the various systems, which, however, he admitted have yet to be fully sifted in the light of practical sea-going experience. He claimed, however, in general terms that the Diesel engine utilises fuel with an economy far exceeding that of any other prime mover, and that the total savings due to its adoption are even greater than those arising from a fuel consumption which is from one-third to one-fifth only of that required for equally powered steamships.

What is being done by British engineering firms to invade the marine oil engine field and the difficulties which have had to be surmounted was revealed by Mr. Summers Hunter. The difficulties of making the change over from building reciprocating engines to manufacturing oil engines were, he said, much greater than many people would credit, and dealing with foundry practice alone, he stated that it was two years before his firm had been able to produce satisfactory Diesel cylinders of large size. At the end of that time they were, however, supplying such cylinders to continental customers. Sir Archibald Denny, who confessed himself a turbine man, said that if the figures showing the economies realised quoted by Mr. Richardson could be established the oil engine would have to be adopted.

## SECTION VI.—WATERWORKS, SEWERAGE AND GASWORKS.

### COMPENSATION WATER.

The first paper taken in Section VI. on Friday, July 1st, was one by Mr. Edward Sandeman, entitled "Compensation Water." The subject is now of exceptional interest owing to the excessive cost of the construction of new works. Practically all large undertakings are obliged to give compensation water to the streams affected, either by a constant or intermittent flow. In some cases riparian owners have accepted a monetary compensation. The quantity to be given is fixed as a proportionate part of the average water available in each of the three driest consecutive years. The author gives a table* showing the variation in the proportion of compensation water fixed by Parliament for various watersheds. These vary from one-third to one-eighth of the available rainfall. In a second table* a comparison of compensation water with dry weather flow is given. These proportions vary from 5.7 to 1.9. The author is of

* Not reproduced.—ED. THE E.

opinion that excepting in areas in which water is required for trade purposes there is no necessity to increase the river flow to so large a figure as has hitherto been customary.

Colonel Davidson (Liverpool) opened the discussion, and gave his experience of the watersheds of the Vyrnwy and Rivington, which agreed with that of the author. For the Vyrnwy there was a uniform daily compensation of 10 million gallons, but it was increased to 40 million gallons per day at certain times, which quite ruined the fly fishing, although Parliament had imposed this requirement at the request of the fishing association. At Rivington the compensation was 8 million gallons per day to supply bleaching works, and that was a case of gross waste. The year 1887 is that from which figures were taken for the Vyrnwy, but unless stream gauging were used, no reliance could be placed on the figures for the driest day. Mr. F. W. Macaulay said that the proportion fixed for compensation water was of special interest in new schemes. On the Elan River the compensation was fixed at 27 million gallons per day in comparison with an ultimate demand of 80 million gallons, but at present only 25 million gallons were being drawn. In Mr. K. P. Hawksley's opinion the remedy rested with the engineers themselves in refusing to give evidence supporting the opposition to the Bills. He objected to penalties which Mr. Binnie had suggested, and considered it better to purchase the water rights from mill owners. He thought it would be fair to fix certain limit gauges and require compensation water to be supplied when the water level fell below those gauges. Mr. Percy Griffith held that no community should be called upon to improve the flow of a river, but to keep it as before. For the greater part of the year mill owners were unaffected, but they seemed to expect the water authority to improve the flow in dry seasons; but Mr. Lewis asserted that it was useless to go before a Parliamentary Committee and suggest a ratio of compensation water less than one-third. At present it is necessary to make reservoirs far larger than they need be. Birmingham was very hard hit, as the compensation ratio was based upon the ultimate demand on both the Elan and Claerwen Rivers. Mr. Henzell (Leeds) thought it a great waste to compensate during the whole year; for Leeds the Washburn reservoir had to be reserved for compensation water. There the ratio was one-fourth, and in time of drought the Washburn reservoir was emptied and the higher reservoirs had to be drawn upon. If an agreement could be made with mill owners, better conditions could be obtained. Leeds had bought up water rights for 20 miles down stream below the reservoir, but it was hampered by the demands of a mill at Tadcaster, 27 miles below. In the Huddersfield district there was a large number of mills, and he thought it would be best to have a compensation reservoir and let the mill owners control it.

### Pipes for Pressure Conduits.

Mr. F. W. Macaulay then read in abstract his note entitled "Pipes for Pressure Conduits." Iron, hitherto almost the sole material for water pipes, has of recent years proved unsatisfactory, particularly for ferruginous waters from upland gathering grounds. Nodules, iron oxides and iron bacteria rapidly diminish the carrying-capacity of the pipes; lime treatment is costly and useless. In Birmingham's 42in. mains the discharge has been reduced 25 per cent. in fifteen years; in Manchester's 44in. mains, 40 per cent. in twenty years, and so on. The only palliative is scraping or brushing periodically. Good cement concrete pipes offer decided advantages, as there is no nodular incrustation produced. Reinforced concrete pipes can be produced of adequate strength for all pressures, and the life of the pipe should be as long as that of an iron pipe or of an ordinary concrete non-pressure conduit. The author gave a list* of towns in which such pipes are in use. They are all of one type. They have a continuous steel tube between and supported by helical steel members, the whole being embedded in concrete. Of late years a new type of reinforced concrete pipe has come into use, in which steel wire reinforcement is embedded in a centrifugally made concrete cylinder. Run lead joints may not be practicable, but malleable lead wire, lead piping, and for light pressures, cement are efficient substitutes.

Opening the discussion, Mr. H. F. Rutter said that the influence of London water on cast iron pipes was negligible. A 30in. pipe had been taken out in his district after 110 years' use, and was found to be as good as when new. He could not say that for the modern pipes made with the hot blast, the product from which, in his opinion, was not equal to cold blast iron. Jointing was the chief difficulty with concrete pipes; bitumen was thought good, but now lead joints seemed to be favoured. Far too little attention was paid to the laying of the pipes; they should be laid on a concrete bed, and on curves great care should be taken to prevent the horizontal thrust on the pipe opening the joints. This view was supported by Mr. C. H. Priestley, who added that he made joints of concrete pipes with molten lead, whilst Mr. W. J. E. Binnie mentioned that the Stanton Ironworks had made experiments on concrete pipes with a collar caulked with lead wool. At a head of 175ft. these joints proved satisfactory. The question of jointing was discussed also by Mr. C. J. Henzell (Leeds), who stated that he offered the makers of concrete pipes an order for 1¼ miles if they would guarantee the joints; he thought that the makers of such pipes should be prepared to give such guarantees. Mr. St. G. Moore said he went to Paris in 1917 to see concrete pipes of the Bonna type which had been in use twenty years; they were fixed in a tunnel unsupported by ground. Mr. Bonna made the joints with lead tubing filled with hemp and cemented over, but they were very expensive.

The author then replied, and said that in Birmingham he had used the Bonna concrete mains 60in. diameter. They were subjected to a test of 135ft. head, and only twenty joints had leaked in a length of one mile. He ought, however, to say that the entire length had been left uncovered and empty, which, he thought, allowed expansion to take place, and that probably accounted for the leaks. He did not like the present Bonna joint, which he described in detail. He had made certain suggestions to Mr. Bonna for improving it, and he thought these would be incorporated in the next designs. The concrete pipes should be supported on a benching of concrete up to the centre line.

* Not reproduced.—ED. THE E.

### The Relation of Run-off to Rainfall.

Dr. H. Lapworth then read in abstract a note entitled "The Relaton of Run-off to Rainfall." The subject had not received in this country the attention which it had attracted on the Continent and in the United States. The mean annual loss by evaporation ranged in Britain from —2in. (or gain) to 28in. According to certain authorities, the mean annual evaporation increased by about 0.7in. for each degree Fah. increase in the mean annual temperature. The problems of seasonal and monthly flows are infinitely more complex than the laws of annual loss in streams. No investigation can prove satisfactory unless the factor of ground storage be taken into account. The dry weather flow is derived almost solely from ground water storage. The extreme dry weather flows in this country appear to range from zero to 1 or more cusecs per 1000 acres in areas of pervious rocks, or of high rainfall, while in relatively impervious gathering grounds with average annual rainfalls of 40in. to 50in. the extreme dry-weather flow is generally found to lie between $^1/_{10}$ and $\frac{1}{4}$ cusec per 100 acres. The maximum rates of flood discharge appear to have no relation to the mean rainfall. It is in connection with stream flows from areas of 100in. or more annual rainfall, and in a lesser degree from those below 30in., that we appear to lack records.

Colonel J. R. Davidson (Liverpool) said that there had been more research in America and Germany than here, and in the United States elaborate records were published and deductions made, which were based on a single year. On the Vyrnwy they had continuous autographic records of the volume passing the weir for the last thirty years. Owing to the presence of underground storage, an accurate average of monthly flow cannot be obtained. Evaporation was assumed to be greatest in hot years, but that was not the case if those years were dry. The Vyrnwy gauge showed an evaporation of 11.8in. for an annual fall of 80in., and 3.7in. for a fall of 40in., while at Rivington the figures were 7.6in. for 50in., and 10.75in. for 30in. The former area had an impervious formation, and the latter pervious, so that the water sank and came up again lower down the valley. Mr. W. J. E. Binnie described a diagram of reservoir storage showing by two curves a comparison of the Deacon diagram with the Hawksley diagram, and Mr. D. H. Thomson exhibited a table showing the effect of ground water storage on calculated annual loss, which had been prepared from records taken by him at Compton, West Sussex, from 1893 to 1920. Diagrams and formulæ were also presented by Mr. Lacey, who gave his Indian experience at great length.

In replying, the author said that formulæ had been severely criticised, but it was obvious that some formula must be used. In his opinion, evaporation increased up to a certain rainfall, and then it remained practically constant for rainfalls above that limit.

## SECTION VII.—ELECTRICITY WORKS AND POWER TRANSMISSION.

### Battery Locomotives.

On Friday, July 1st, Mr. James Dalziel read a paper before Section VII. on "Battery Locomotives." Electric shunting locomotives, the paper explains, may be operated from overhead wires or from a self-contained battery. Generally speaking, battery operation is most suitable where the work is moderate and fairly uniform, and especially where fairly long lengths of infrequently worked sidings are involved. In such cases the author considers that battery locomotives will economically replace horse or capstan shunting. It is also pointed out that a probable field for battery traction on electrified lines is that of working wayside sidings with a battery tender to supply the main line locomotive. Shunting in large goods yards will in all probability be best effected by locomotives combining overhead conductor with battery supply, the battery dealing with the lightly worked sidings. Where the obstruction of an overhead wire is objectionable, as on quay sides, battery operation is the only form of electric traction possible. But battery traction alters for the worse the operating characteristics of an electric locomotive, especially as regards overload capacity. Straight battery working is not suitable for heavily worked sidings or those out of which an occasionally heavy load has to be drawn, and the same applies to heavy gradients on which, at certain hours of the day, especially heavy trains have to be handled.

The paper describes a battery locomotive which was built by the Midland Railway in 1913 to supersede horse shunting in a London coal yard. Standard wagon parts can in general be used in the construction of these engines. Speakers who took part in the discussion dealt with the subject from various standpoints. It was pointed out, for example, that there is a field for battery traction on small branch lines from 2 to 3 miles long, and on which the employment of overhead wires might not be desirable even in the event of general electrification. The question of charging the batteries at the proposed standard pressure of 1500 volts was also discussed. For this pressure a motor generator mounted on the locomotive was considered essential owing to the wide difference between the voltage of the supply and that of the cells, but with a 600-volt supply the practice of charging through a resistance was considered permissible. A statement made by the author to the effect that ordinary flat plate batteries were satisfactory in use did not altogether meet with the approval of the representatives of battery firms which have developed special cells for traction service. A good deal was said about the low speed of battery locomotives. Other matters discussed were the possibility of battery explosions, the use of capstans as an alternative to battery engines, the effect of boosting charges on the life of cells, and the question of increasing the mileage by the introduction of regeneration. In common with the author, several of the speakers did not consider that battery explosions were worth bothering about if adequate ventilation was provided, but a report recently issued by the American Bureau of Mines shows that in America a fair number of these explosions has been experienced.

### Electric *versus* Steam Locomotives.

After Mr. Dalziel's paper had been read those present joined the Machinery Section—No. III.—before which Sir Vincent L. Raven read a paper on "Mechanical Advantages of Electric Locomotives compared with Steam." Briefly, the mechanical disadvantages of the steam locomotive are summarised as follows:—The locomotive being a complete unit, its power cannot be greater than the capacity of its boiler. To increase the boiler capacity obviously implies increased dimensions and weight, both of which offer grave difficulties with regard to clearances and the strengthening of bridge structures. On many railways in Britain the limit of weight has been reached, and further development of power is only possible at enormous expense. The boiler, cylinders, valve gear, crank shafts and all reciprocating parts are costly to maintain. Turntables, fuelling and water supply appliances must be provided. The cab is small and open to the weather, involving discomfort to the crew. The locomotive radiates heat and uses coal all the time it is under steam and during the many hours it is doing no work and either standing by or waiting. The wear and tear of the locomotive on the track is considerably increased by the impossibility of balancing the reciprocating parts. The case for the electric locomotive is set out by the brief statement that it is not hampered by any of the above objections. It is also shown to possess simplicity of mechanical construction and operation; increased power of acceleration; higher scheduled speed, due to the possibility of heavy short-period overloads, resulting in more frequent service and increased use of existing tracks; uniform turning effort, resulting in a better factor of adhesion at starting and on gradients; absence of all reciprocating movement and accurate balance of all rotating plants; facilities for driving from either end of a locomotive; accessibility of mechanical and electrical parts; better accommodation for locomotive crew by reason of increased cab area and by closing in and heating the cab; and, lastly, the possibility of coupling two or more locomotives together under the control of a single driver. The discussion showed pretty clearly that antagonism to electric working has now practically disappeared. At any rate, those railway engineers present who have tried it were clearly very desirous to see the system make further headway. Only one speaker—Mr. H. N. Gresley—was found to defend the steam locomotive. Attention was called to the possibility of working main lines with a much smaller number of electric locomotives than the number of steam locomotives now in use, but it was pointed out that in view of the high cost of the electric engines they should, as far as possible, be kept in constant service. A good deal of the discussion, however, did not cover new ground. Much was said, for example, about the relative advantages of geared locomotives as compared with those fitted with connecting rods, but that, of course, is a matter that has frequently been dealt with in America and on the Continent. The general opinion appeared to be that electric locomotives should be devoid of reciprocating parts, and that, as far as possible the driving equipment should be placed inside the cab, where it can easily be inspected. The only direction in which

the steam locomotive is more simple than the electric locomotive is, it was argued, in connection with the control gear. At times it appeared that the discussion was going to develop into one on the relative merits of different systems, but diversion from the subject of the paper was somehow avoided. When Sir Philip Nash mentioned that a direct-current pressure of 1500 volts had been standardised Sir John Aspinall, who spoke later, appeared to have concluded that that also meant that the third rail had been standardised, and Mr. Dalziel, in speaking towards the end of the meeting, expressed great disappointment in respect of this matter, as the overhead conductor had, he contended, great advantages. Sir Philip Nash explained, however, that although a pressure of 1500 volts had been standardised there was no intention whatever of standardising the third rail. The desirability of having electric locomotives built by outside firms instead of by the railway companies themselves was also referred to in the course of the discussion.

## THE INSTITUTION OF MECHANICAL ENGINEERS.

In the Committee Room of the Institution, Dr. T. E. Stanton took the chair on Friday, July 1st, when two discussions were opened, the first by Mr. C. E. Stromeyer on "Feed Heating and Economisers," and the second by Professor W. E. Dalby on "The Indicator as an Aid to Economy."

In his short paper Mr. Stromeyer was able to call upon a ripe experience of the practical use of economisers gained during his association with the Manchester Steam Users' Association. In the circumstances it is not surprising that he devoted his attention principally to the operation of economisers, and discussed their economical value hardly at all. He dealt principally with external corrosion and internal incrustation, mentioning with regard to the former that cold feed must not enter the economiser, as it causes acid moisture to deposit from the flue gases on the tubes. For the same reason the temperature of the gases leaving the economiser should not be less than 100 deg. Fah. With regard to incrustation, he pointed out that whereas in a boiler the effect of the variation in thickness of the incrustation was only to cause more of the heat to be transferred further along the tube and less near the furnace where the deposit was thickest, in an economiser the heat gradient was in any case so small that incrustation was injurious. He advocated the employment of the counter-current system, and insisted that the explosion which had caused prejudice to arise against that system was due to defective design which produced water-hammer and not to the system itself.

The discussion was rather disappointing. It was opened by Mr. Halpin, whose excellent work in connection with hot feed is well known. He mentioned cases in which the substitution of hot for cold feed had resulted in an increase in the rate of evaporation of 17 per cent. In another case the evaporation had been raised from 11,000 lb. per ton of fuel to 17,500 lb. Another speaker expressed disapproval of the counter-current system, which he believed to be dangerous, and which American tests had shown to be less economical than was to be expected. He thought tubes ought to be scraped continuously and not only at intervals. Dr. Stanton referred to Osborne Reynold's experiments on the relationship between heat transference and the rate of flow of water in a tube, and in his reply Mr. Stromeyer said that in view of the higher pressures now coming into use he regarded the use of cast iron economiser pipes with some suspicion. Steel would be preferable, but as the pipes would be thinner pitting might be serious. We venture to prophesy that some day, if economisers are still used, stainless steel pipes will afford the desired solution of this problem.

Professor Dalby was unable to be present to read his paper on indicators, and in his absence it was presented by Mr. Mitchell. The author deals entirely with the use of the indicator on internal combustion engines, and discusses the optical type only. The principal value of the indicator is the information it gives about valve setting. Optical indicators may be divided into two types, according to the method of recording the pressure: (1) the piston type; (2) the disc type. The difficulty with the piston type is that the moving parts cannot be reduced to such a small mass as the disc type, so that its upper speed is limited. The advantage of the disc type is that it is capable of reproducing all the delicate variations of pressure in the cylinder, just as a telephone disc is capable of reproducing the delicate variations in speech. One of the disadvantages of the disc type is that the disc gets hot, so that there is a slight change in its scale, but this is immaterial when considered with its many advantages, and, moreover, can always be allowed for if exact measurement of the horse-power is required.

The discussion turned mainly on the relative merits of the piston and disc types of indicators, Professor Burstall advocating the piston type because, whatever might be said to the contrary, the heat effect on the disc was serious. On the other hand, Mr. Hodgson was opposed to the piston type on account of its friction, and Mr. Mitchell stated that Professor Watson had found only a 2½ per cent. error due to the heat effect on the disc. That could hardly be regarded as serious. It seemed to be generally agreed that up to three hundred revolutions per minute trustworthy results could be got with the piston and pencil type of indicator.

## A 500 Horse-power Combined Engine and Boiler.

THE 500 horse-power "locomobile" plant illustrated on page 94 and in our two-page Supplement is believed by the makers, Robey and Co., Limited, of Lincoln, to be the largest example of this class of prime mover so far constructed in this country. The plant consists of a compound engine mounted over a circular boiler, having a circular furnace and tubes which are withdrawable, and is provided with a superheater in the smoke-box and a feed-water heater. It can be supplied, the makers tell us, either condensing or non-condensing. The leading dimensions of the cylinders are as follows:—16½in. diameter high pressure and 28in. diameter low pressure, each having a stroke of 24in. The engine is fitted with a fly-wheel 9ft. diameter grooved for twelve 1¾in. diameter ropes, and running at 160 revolutions per minute. The boiler pressure is 180 lb. per square inch. When working condensing the engine is designed to develop the following powers:—450 brake horse-power (economical load); 520 brake horse-power (maximum continuous load); or 570 brake horse-power (temporary emergency load). If working non-condensing the designed outputs would be:—335 brake horse-power (economical load); 380 brake horse-power (maximum continuous load); or 420 brake horse-power (temporary emergency load).*

It will be noticed from the general arrangement drawing of the engine given in the Supplement that the cylinders are attached to the main bearings by means of bored guides and a cast iron baseplate which carries the main bearings. In this way the whole of the engine stresses are transmitted through these castings, and not in any way through the boiler. The cylinders are attached to planed seatings and steel plate brackets on top of the boiler, but the bed-plate is carried by two heavy cast iron standards from the foundation, so that the expansion of the boiler shall not affect the engine. On smaller engines there is no objection to carrying the whole of the engine on the boiler, but on units of the size of that illustrated, in which the amount of expansion is considerable, the makers prefer to make the bed quite independent of the boiler. This arrangement, it is claimed, has the further advantage that the crank shaft can be quite safely direct-coupled to a generator shaft or any other shafting, as its position is definitely fixed and is not subject to movement, as it might be if it were carried by the boiler.

The crank shaft is fitted at one end with a rope fly-wheel capable of transmitting the full power of the engine. If the engine is condensing the air and feed pumps are driven from the fly-wheel end. If the engine is non-condensing, the fly-wheel is fixed on the low-pressure side and the feed pump on the high-pressure side. The reason for placing the air pump on the same side as the fly-wheel when the engine is condensing is that the air pump has to be on the low-pressure side; the fly-wheel also has to be on this side, as at the other there would be too much overhang by reason of the space taken up by the skew wheels driving the high-pressure valve shaft.

The high and low-pressure cylinders are combined in a single casting, a liner being fitted to each cylinder. The high-pressure cylinder has its steam chest cast on top, and at the bottom of the combined casting is a piston valve chamber for operating the high-pressure exhaust and low-pressure admission and exhaust. The steam is admitted to the high-pressure chest by means of a screw-down stop valve with an extended spindle, the hand wheel of which can be conveniently operated from the engine platform. The front of each cylinder is cast solid in order that there may be no steam joint at this end between the cylinder and bored guides, and provided with stuffing boxes for taking "United States" metallic packing.

The high-pressure cylinder valve gear consists—as shown in one of our engravings—of a double-beat admission valve at each end of the cylinder driven from a valve shaft at the side by means of excentrics and cam and roller gear in each bonnet. The two steam valves are each made with a special flexible top seat so that the valves may adapt themselves to any changes in the temperature of the steam—such as is likely to occur with superheated steam—and still maintain their tightness. The seats for the steam valves are cast separately from the cylinders, and are forced into position in the steam chest, their tightness being maintained by means of soft copper rings. They are held in position by means of a stud and nut, the stud being arranged with a special end, which, it is stated, makes it impossible for it to get loose. The valve spindle is not provided with any metallic packing. It is instead grooved and ground and works in a very long bush, which arrangement, it is claimed, obviates any possibility of the valve sticking and still allows it to remain quite tight. The top of the valve spindle is attached to a bridle, the upper end of which is turned to fit into the guide in the bonnet. This upper end carries a roller, which is actuated by a cam fixed to a fulcrum pin in the bonnet and worked by an excentric on the valve shaft. The excentric is moved relatively to the shaft by means of a pin carried by the governor, so that the cut-off is varied while the lead remains constant.

The governor is of the combined centrifugal and inertia type, and turns through a small angle relatively to the shaft when there is any change of load. The end of the valve shaft is bored, and a special arrangement is fitted, which is such that the tension of the governor springs can be varied while the engine is running, thus enabling a slight variation of the engine speed to be obtained by means of the hand wheel shown at the end of the valve shaft. A piston valve is fitted in the lower part of the casting, which acts, as previously mentioned, as an exhaust valve for the high-pressure cylinder and as a steam and exhaust valve for the low-pressure cylinder. This valve is driven by means of a rocker arm carried between the two bored guides, the rocker arm being actuated by means of an excentric fitted between the two inner webs of the crank shaft. All the spindles and excentric rods are provided with adjustments so that each valve may be adjusted quite independently.

The pistons are of cast iron fitted with Ramsbottom rings. The crossheads are of steel, and are fitted with Messrs. Robey's special design of gudgeon pin, which is coned at one end and fitted with a spring cone at the other, with the object of ensuring absolute tightness in the crosshead. The cast iron slippers are fitted with white metal linings. The connecting-rods are solid at the crosshead end, and of the marine type at the crank pin end, both ends being adjustable. It will be noted that the crank shaft has the crank pins opposite one another instead of at right angles, as is more usual. This departure is necessary on account of there being one common distribution valve between the high and low-pressure cylinders. The crank shaft main bearings are of the four-part ring oiling type, having cast iron shells lined with anti-friction metal. The wedges for the side bearings are of the makers' special circular type, with which it is claimed to be impossible to make an unequal adjustment, and so nip the shaft as can occur in the case of flat wedges. The bearings are carried in the main bed-plate casting, which also forms a crank case, and which is provided with a loose top cover, so that the crank case is completely enclosed.

The exhaust from the low-pressure cylinder passes through a feed-water heater of the tubular type, and when the engine is condensing through a jet condenser of the spray type to a horizontal air pump on the low-pressure side. The air pump, when fitted, consists of a horizontal double-acting plunger which opens inlet ports on the centre of its cylinder. The pump is fitted only with delivery valves, no suction valves being required, and is driven through a bell-crank lever by a connecting-rod from a small crank at the end of the engine shaft. The feed pump for delivering the water through the feed-water heater and into the boiler is of the horizontal type, and is attached to the air pump base plate when the engine is condensing. It is driven from a small lever on the air pump rocking shaft. When the engine is non-condensing the feed pump is arranged on the high-pressure side of the engine, and is driven by an excentric fixed on the shaft outside the box enclosing the skew gear which drives the valve shaft. In this case the feed pump is of the vertical type. As an alternative method of feeding, an injector is supplied.

The whole lubrication system of the engine is arranged for continuous running, the two cylinders being each lubricated by a mechanical sight-feed lubricator driven from one of the high-pressure admission valve excentric rods. The bored guides, crosshead pins, metallic packing, and the central piston valve rocking shaft lever and valve spindle guide are all lubricated from a central box provided with adjustable sight feeds. The main bearings, as previously mentioned, are of the ring oiling type. The crank pin bearings and the central excentric are lubricated by means of centrifugal oiling rings from sight-feed lubricators carried on the crank case cover.

The boiler is constructed for a working pressure of 180 lb. per square inch. The barrel is made of two plates only, so that there are no circumferential seams. The shell is carried on cast iron cradles. The furnace is of the corrugated type. The fire grate can be extended to suit the quality of fuel being used by bolting an extension on to the front of the boiler. As mentioned previously, the furnace flue and all the tubes may be removed from the boiler for examination and cleaning by removing the nuts at the boiler front and smoke box end.

The smoke box is of considerable length, as in it are arranged the superheater elements. These elements, it will be seen from one of the engravings, consist of a large number of small diameter bent steel tubes, expanded into three headers. The steam from the boiler stop valve enters the top header—which is divided into two parts—at the chimney end, and passes through the bent steel tubes to two bottom headers, one at each side of the smoke box. Thereafter, by means of a second series of tubes, the steam returns to the second half of the top header, which has an outlet branch cast on to it. The steam thus leaves the smoke box at the point at which the gases have the highest temperature. The smoke box door opening is large enough to allow the whole of the superheater headers and tubes to be drawn out complete. A special feature of the superheater is that the bent tubes are so arranged that all the boiler tubes are accessible for cleaning as in an ordinary boiler. The superheater is fitted with a spring safety valve, and the bottom headers with drain cocks, by which all water in the superheater may be drained away. A steam jet and valve are provided for cleaning the superheater coils. The whole of the boiler barrel and smoke box are lagged.

* The plant was completed during the coal strike, and by reason of the shortage of fuel, had to be sent off without consumption tests being taken.

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THE bridge which is to connect Canada and the United States, across the Detroit River at Windsor will, it is said, be completed by 1926. It will be of the suspension type, and span the river at a point where the channel is narrowest. It will be 1805ft. long and 110ft. above the water at the highest point in the span. Besides the eight cables, the bridge structure will require 80,000 tons of steel.

IN view of the continued drought, the Metropolitan Water Board has announced that it is forced to contemplate the necessity of further restriction of water in the near future. Hitherto the Board has refrained from any curtailment of the supply of water for trade purposes apart from an appeal for strict economy in its use, but the demand under this head on its resources continues to be very heavy, and it is only on evidence that voluntary efforts on the part of traders can succeed in the reduction of consumption that the Board can justify to the public the continuance of a supply for trade, which might jeopardise ultimately the supply for domestic purposes. The Board, therefore, earnestly appeals to all users of water for trade purposes to reduce their consumption by all means in their power and thereby to avert the necessity of the Board having temporarily to cut off the supply.

# A Seven-Day Journal.

## Memorial to Thomas Newcomen.

ENGINEERS all over the world were present in spirit yesterday at Dartmouth when a memorial to Thomas Newcomen, the local blacksmith who has stamped his name on the history of engineering, was unveiled. Newcomen was born in Dartmouth in 1663, but he died and was buried in London, his resting place being Bunhill Fields, where Defoe and Bunyan were also interred. The famous inventor did not gain any real material advantage from the invention of the engine which bears his name, and he left no materials for a biography. The house in which he lived at Dartmouth has been demolished, although some of the carving has been preserved. The memorial which his native town has erected takes the form of a block of Dartmoor granite 6ft. high by 4ft. wide, on which is an oxydised brass plate bearing a line engraving of Newcomen's engine and an inscription.

## Tramways and London Traffic.

COMPLAINTS are being made by the London County Council that its schemes of tramway extensions, with the object of giving improved facilities for street transport, are being seriously retarded by the delay on the part of the Government in taking steps to deal with the traffic questions which were raised in the report of the Committee which has just investigated this subject. It has been decided that no application will be made to Parliament by the Council for new powers and schemes which have been abandoned, at least temporarily, are those for linking up with the Embankment tramway system the line which has its terminus at the Holborn end of Gray's Inn-road, as well as with the dead end at Farringdon-street. A report which was submitted at Tuesday's meeting of the Council stated that the present position of affairs makes it impossible for the Council to obtain adequate consideration on their merits of schemes necessary for the development of the tramway system. A remedy will not be forthcoming, it was suggested, until there has been a complete and considered re-organisation of the existing systems of local passenger transport in the London area.

## Lloyd's Register Appointment.

THE selection of Mr. Bernard J. Ives to the post of assistant to the Chief Ship Surveyor of the Society, Sir Westcott Abell, is an admirable one. Mr. Ives has been recalled to the head office from the Continent, where he has acted as principal surveyor for some years past. In this capacity he has had a great deal to do with the extension of the activities of the Register in foreign countries, and the experience he has gained during these changes should give him an additional qualification for the post he will in future occupy. He is in close touch with shipbuilding developments in many countries which have aspirations to occupy a more important place in the industry, and it was felt that his proper place was at the headquarters of this great organisation.

## High Wages and Unemployment.

IT is announced from Adelaide that following the decision of the Board of Industry to increase the living wage by an additional 9d. per day, thus raising it to a total of 13s. 3d., a number of establishments have had to close down. The managements of other businesses have stated that this rate of pay is impossible under present conditions. The position appears to be a critical one; unemployment is increasing, but the Board of Industry, which, it should be noted, is constituted of representatives of both employers and employed, refuses to take the responsibility of maintaining wages at the old level, which, they assert, is inadequate to meet the present high cost of living.

## German Engineering Combine.

FUSION of engineering interests in Germany continues. It is announced that the Dusseldorf Machine Works, which are now being re-organised with a view to undertaking the construction of locomotives and rolling stock, is to be amalgamated to a certain extent with the A. E. G., Krupps, Lincke-Hoffmann, and other well-known engineering enterprises. With the object of facilitating export trade, the Wolff interests, whose headquarters are at Cologne, will be included in the new combine.

## Improvement of Inland Waterways.

THE recommendations made in the report of the Committee of the Ministry of Transport on Inland Waterways have been an open secret for some weeks past, and were referred to on this page at the time the report, which now makes a belated issue, was presented to the Ministry. It is desired to take steps before the Railways Bill becomes law to provide for the transfer to the Public Trusts proposed for the waterways of any railway-owned canals which may be included in an improvement scheme. Nationalisation being out of the question, it is suggested that steps should be taken to bring about the amalgamation of the various undertakings by a Public Trust system. These trusts should, it is suggested, be composed of representatives of various bodies having interests, financial or otherwise, in the working of the waterways system, and should possess power to act as carriers as well as toll-takers. It should be made impossible by legislation for any railway group to quote rates or give special services free of charge for the purpose of crushing out competition by a Waterways Trust in a particular area. The Committee divide the canals into seven groups, these groups being Trent Navigations, Yorkshire Canals, Lancashire Canals, Canals joining Liverpool with Midlands, River Severn, River Thames and Midlands and Bristol, and Birmingham Canal and Midland system. The river Trent and its connections are selected as being eminently suitable for the first experiment, and this opinion of the Committee will be widely shared by all those who have made a study of the waterways question. It was understood when the Committee was formed that Mr. Neville Chamberlain, the chairman, obtained assurances that any well-considered scheme of improvement which did not involve large capital expenditure would receive favourable consideration, and the outcome of the proposals made in the report which meet this condition is awaited with much interest.

## Mammoth Ex-German Liner.

THE United States Shipping Board is called upon to make a somewhat momentous decision. The ex-German liner Vaterland, re-named the Leviathan, was, it will be recalled, assigned to the United States. The question at issue is whether the ship shall be broken up or re-conditioned for Atlantic service. The new chairman of the Shipping Board appears to be in favour of having the Leviathan re-conditioned and converted to an oil-burning ship. In any event the work would occupy a considerable time, and conditions in the shipping industry may, it is hoped, improve before the Leviathan could be ready to go into commission. The chairman of the Shipping Board is not favourably impressed with the position of this State enterprise, and in a public statement just made he expressed his belief that he had inherited perhaps the greatest commercial wreck in history, the operations of the Shipping Board having already resulted in a loss to the country of £1,000,000,000. If the Leviathan is re-conditioned she will be operated by the International Mercantile Marine under the American flag.

## Coal Industry Wages Board.

THE National Wages Board for the coal mining industry has now been established. It is constituted of twenty-three representatives of the miners and an equal number of representatives of the coalowners, and the Lord Chief Justice has been asked to nominate an independent chairman. The first meeting of the Board will be held on Thursday next. The Miners' Federation and the coalowners' organisation are also giving attention to the method by which costs of production can be determined. It has been decided to enlist the services of two firms of accountants, one to be nominated by employers' representatives and the other by the miners' organisation.

## Future of Airships.

THE technical and expert Committee appointed by the Imperial Conference has lost no time in making a start with the work entrusted to it. The Committee, which includes Lord Gorell, Air Marshal Sir H. M. Trenchard, Major-General Sir F. Sykes, Sir G. L. Barstow, Sir James Stevenson, Sir Ross Smith, and Colonel H. Mentz, has decided to prepare estimates for the provision of a limited service. It is recognised that even if the existing fleet is utilised to its full capacity it will not be possible to do more than provide a service—possibly irregular—for passengers and mails to the eastern boundaries of the Empire. At the outset consideration is being given to the utilisation over certain sections of Imperial air routes—the Cairo-Karachi route is named in this connection—of heavier-than-air machines.

## Railways and Road Transport.

THE representations made by Mr. Arthur Watson and Sir Henry Thornton to members of Parliament in support of the claim that railways should be granted extended powers to engage in road transport appear to have impressed their audience. A good point made was that the railways as large ratepayers make important contributions to road maintenance, and are therefore, having regard to the strong position which is being attained by road transport, subsidising a rival agency. It is the fact also that certain companies, including the Great Eastern, the North-Eastern, and North Staffordshire Railways, possess ample powers to extend their road transport services, so that when the grouping scheme is carried out these railways will be able to exercise such powers while their partners will be prevented from doing so. Railway companies do not, it is asserted, desire to obtain a monopoly of road transport even if it were possible, and are willing to allow the same safeguards as apply to railway rates under the Railways Bill to apply to rates for road transport. Their desire is to improve their services by the use of the road motor as an auxiliary to the railway, as well as to employ the road vehicle to test the traffic possibilities of particular areas to ascertain if the construction of a light railway would be justified. Sir Henry Thornton was able to show that the Great Eastern Railway has by its road motor system rendered useful service to traders. An attempt is to be made to obtain the necessary authority for all railways to extend their road services on the report stage of the Bill.

## Ship Joiners' Strike.

ONE immediate result of the refusal of the ship joiners to come into line with other branches of labour in the shipbuilding and engineering industries is the decision to close down Vickers' works at Barrow from to-day until August 9th. It is stated that the joiners' strike has already made it necessary to send one of the Cunard liners, the Scythia, built at Barrow, to a French yard to be completed, and that work on another Cunarder, the Antonia, is at a standstill and is being seriously delayed on steamers building for the Australian Government.

## University of Bristol Appeal.

THE strain of finance is being felt at Bristol, as at other Universities, and an appeal is being made for public subscriptions to enable necessary improvements and extensions to be carried out. It is sometimes overlooked that Bristol University has a strong technical faculty, which it owes to the generosity of the Society of Merchant Adventurers. This faculty has a chair of automobile engineering, and the Department of Pure Science has been recently endowed by Lord Leverhulme with a chair of physical chemistry. Other new chairs are required, and additional funds must be found if men of the right type are to be secured for the teaching staff. The University has a heavy accumulated debt, and is at the same time faced with the difficulty of financing the erection of new buildings.

## Long Distance Wireless.

A STATEMENT which has been made by Mr. Marconi on his return to London this week predicts a somewhat important development in the reception of wireless messages. The new method has been tested by Mr. Marconi during a voyage from the United States, and it is understood that he has been able to receive continuously throughout the voyage messages from the United States without the atmospheric disturbances which are usually experienced at this period of the year. This advance in methods of reception will, it is suggested, enable a wireless service to be conducted at high speed during the whole twenty-four hours of the day. Mr. Marconi appears to have been much impressed with the practical value of the achievement now made, the credit for which is assigned to one of the Marconi Company's engineers.

## Sale of the Dreadnought.

THE sale of the Dreadnought, the pioneer of the modern battle fleet, which was announced as impending a few weeks since, has now been made. This famous vessel has been sold to a well-known firm of shipbreakers for the comparatively small sum of £44,000. The original cost of the ship was £1,750,000. It cannot be doubted, however, that the decision to dispose of the Dreadnought and a number of other warships which had reached the stage of obsolescence is a wise one.

## New Capital Ships.

IT would appear that after all it is not intended to lay down any of the new capital ships in the naval dockyards. All the contracts will therefore be placed with private firms. The list of yards where ships of the type contemplated could be built is not a long one, and it would not be difficult to make a guess as to the precise allocation of the orders to particular yards on the Clyde and the North-East and West Coasts. It is expected that the call for tenders will be made about the beginning of September. The reason for abandoning the idea of building at least two of the vessels in the dockyards are the cost and length of time which would be involved in making the necessary alterations to the building slips. Strong protests against this decision have been made by Devonport interests.

## Developments in Power Station Design.

No. II.*

In the case of the Holbeck pulverised fuel system, as installed in the Hammersmith electric generating station, the coal is discharged into the unloading hopper A—Fig. 1—and is fed on to a belt conveyor B by a revolving table feed. Whilst the coal is on this conveyor it passes under a magnetic separator

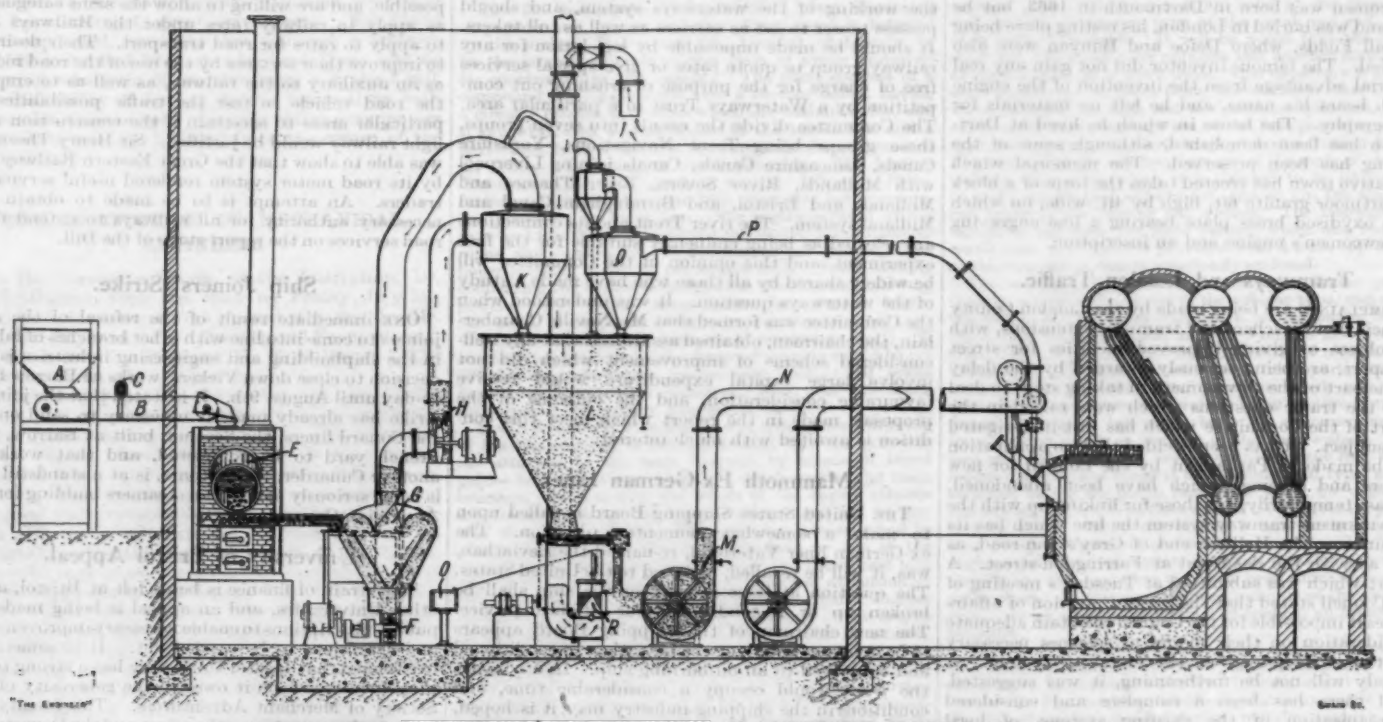


FIG 1—ARRANGEMENT OF PULVERISED FUEL INSTALLATION AT HAMMERSMITH ELECTRIC GENERATING STATION

C, and any "tramp" iron that is mixed with the coal is extracted. The belt conveyor delivers the coal into a rotary dryer E, which reduces the moisture in the coal to 1 per cent. or less. From the dryer E the coal is delivered into a small bin which feeds the pulveriser F. The desired grade of fineness is obtained by means of an air separator G, and the finished powder is taken through an exhauster H to the main collector K, from which the coal falls into the bin L, and the air is returned for re-usage in the pulverising mill. From the powdered coal bin L the fuel is taken by means of screw conveyors to the suction side of the distributing blower M, which delivers the powdered coal, and the primary or conveying air into the main distribution pipe N, the amount of air delivered to the mains being controlled by a variable speed motor which is governed by an automatic regulator O. The ratio of coal and primary air always remains constant, irrespective of the demands of the boilers which are being fired. This mixture of powdered coal and primary air is so rich in the former that it is not inflammable, and before combustion can take place secondary air must be added at the fuel burners. The fuel that is not required at the boilers which are being fired is conveyed through a return pipe P to a return collector Q, and this coal is again delivered into the powdered fuel bin, whilst the air which carries this fuel throughout the system is drawn off from a return collector from the suction side of the distributing blower.

Any number of boiler furnaces can be fired irrespectively of their positions in the central station or other works, and owing to the automatic control of the fuel supply any number of units can be operated at the same time, for the actual amount of powdered fuel and primary air passing through the mains is controlled automatically and in proportion to the fuel requirements at any moment. As the air used for conveying the coal dust is also made to serve to some extent for combustion the actual consumption of power for supplying the coal dust to the furnace is very low. Moreover, air distribution eliminates storage bins at each furnace. It also eliminates the hanging up of coal dust at the furnaces and so avoids avalanches and flashing past the controller and the consequent smothering of the fire. In a few minutes after the furnaces are shut off all the coal dust in the distributing system is returned to the pulverised coal plant.

The Bonnot pulveriser mill which is used in conjunction with this system is designed to crush all classes of coal ranging from 1in. cube down to impalpable powder. The wearing parts, comprising the grinding rings, the grinding race and the driving head, are all made of steel, and they can easily be inspected or taken out on the removal of the cover plate; but it is worthy of note that the wear on the rolls and race does not affect the action of the mill until the rolls have worn down sufficiently to make an appreciable difference of their weight. The grinding race is a steel ring with its axis horizontal and concentric with the shaft, and the face of this ring forms the grinding surface on which the grinding rolls run. The rolls are free to press outwards under the action of centrifugal force, and the coal is crushed between the race and the rolls. The driving head, besides driving the rolls, throws the powdered coal upwards and draws any particles of partially ground coal on to the grinding surface. The shaft bearings are outside the grinding zone.

The separator G, which is placed immediately over the pulveriser and is made of thin sheet metal, is fitted with side flues and adjustable shutters. A partial vacuum is set up in the separator by the exhauster H, and the adjustable shutters regulate the amount of drop in the velocity of the air current at the shoulder of the separator, and this drop of velocity allows the coarser particles of the coal to fall back into the grinding zone whilst the lighter particles are drawn up through the exhauster. For most purposes the desired degree of fineness is obtained when 85 per cent. of the powdered coal will pass through a screen having 40,000 perforations to the square inch, and 95 per cent. through a screen having 10,000 perforations to the square inch. In special cases, however, a higher degree of fineness can be obtained. All fans that have to deal with air carrying powdered coal in suspension are of special construction. The collectors are pear-shaped and octagonal in section, and are made of sheet steel which is rendered rust-proof. Their functions are to separate the powdered coal from the carrying air, to deliver the powdered coal into the powdered coal bin and, in the case of the main collector, to allow the free air to be drawn off and returned to the mill, and, in the case of the return collector, to the suction of the blower. The air, laden with powdered coal in suspension, enters the collectors tangentially, and at a certain velocity which, when the mixture enters the large area in the collectors falls. The reduction in velocity and the changes of direction produced by the particular shape of the collectors allows the powder to be deposited at the bottom, whilst air is free to be drawn off from the top. The return collector is placed at the end of the circuit of the main, and any coal that is not used in the boilers is returned to that collector, and it falls into the storage bin. The air indicator shown at R is composed of a floating cone which is placed in the suction of the blower. If more air is required the cone rises, but if less is needed then falls and the graduated scale indicates the volume of air that is being used. The movement of the cone is transmitted to the automatic regulator by means of a light wire cable, and the regulator governs the speed of the powdered coal feed screw, according to the amount of air passing through the air indicator and mains, thus ensuring a constant mixture of fuel and primary air in the main and controlling according to requirements the amount of air driven through the system. When a burner is opened the air pressure in the main is diminished, and this causes the blower to deliver more air. The consequent opening of the air intake valve causes the coal feeder to operate at a higher speed, so that relation of the air to coal is maintained constant. The burners themselves are made in several types

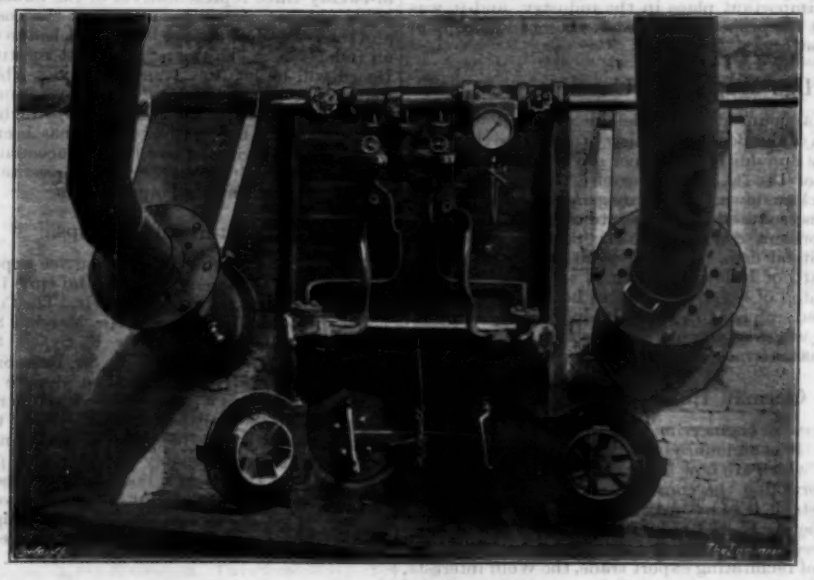

FIG. 2—THOMSON BOILER FITTED FOR PULVERISED COAL OR OIL FUEL

* No. I. appeared July 15th.

and sizes, to enable any desired kind of flame to be secured, and in some cases they are provided with water-cooling arrangements.

When a group of boilers a considerable distance from the main pulverising station has to be fired with powdered fuel it is sometimes preferable to fire it from a sub-station. The coal is delivered in bulk to the sub-station by small diameter high-pressure mains, and is collected at the sub-station and delivered to a powdered coal storage bin, from which it is then delivered to the boilers by low-pressure mains. The mixture of air and coal in the mains is too rich to be inflammable. Moreover, its velocity is approximately a mile a minute, and before the powdered coal can be burnt at the boiler it must be met by a current of secondary air at the burner. Two pulverisers made by the Powdered Fuel Plant Company were supplied some little time ago to a central station equipped with a Babcock marine and Thomson boilers. One of the pulverisers was originally intended to serve as a stand-by, but it was ultimately found that both machines could be kept in continuous use, and one was fitted to a Babcock and Wilcox marine type boiler with a heating surface of 6994 square feet, and the other to a Thomson boiler, as shown in Figs. 3 and 4. The latter, we are informed, has given the best results, but details of the tests are not yet available. The following, however, is an abstract of a report on the test made on the Babcock boiler. Analysis of coal used (rough Yorkshire slack): Volatile content, 30 per cent.; ashes, 22.15 per cent.; moisture, 8.65 per cent. (as fired); B.Th.U., 9797; efficiency, 81 per cent. After the pulverisers had been running for about five or six months an order was placed for four additional machines for firing Babcock and Wilcox marine type boilers.

Another pulverised fuel plant which was built by the same company is shown in Fig. 3; in this case the pulveriser is placed directly in front of the boiler. The "turbo" pulveriser is composed of a pulverising mill and fan combined, and coal is fed into the machine by an adjustable revolving table, whilst the machine is driven by an electric motor at the opposite end, and a revolving table regulates the amount of coal fired. A hopper can be fitted at this point for holding sufficient coal for an hour, a shift, or for a day's run, according to the conditions of work. The air supplied to the mill is admitted at two points. A certain proportion is allowed to enter at the same end as the coal by means of an adjustable shutter inlet, and this air governs the velocity of the drift through the mill, thus regulating the fineness of the powder according to requirements. Additional air is also allowed to enter between the pulveriser and the fan, and it may be regarded as the carrying air for the distributing system. The air supplied from these two sources may be kept below the theoretical amount required to support combustion in relation to the amount of coal used, and the additional amount of air required for combustion can be induced at the burner. Even if the mixture in the distributing pipe is allowed to become inflammable the speed of the mixture in the pipe is such that there is no chance of back-firing. The hopper above the automatic coal feeder can either be charged by hand or mechanically. If the coal received is mixed with "tramp" iron, such as spikes, pick ends, &c., it may be advisable to place a magnetic separator at some suitable point in the coaling system. It will readily be perceived that small coal is most suitable, for apart from the fact that it is cheaper and more easily obtained than large coal, it is more readily pulverised, it requires less power, and there is less wear on the grinding plant. These turbo pulverisers are intended to deal with coal of not greater size than 1in. cubes. If the coal is larger than this, a primary crusher is requisite. Pulverisers of this type are set to work successfully with coal having a volatile content as low as 7 per cent. Provided the coal is suitable in other respects, there is no restriction regarding the ash content, but it should be remembered that useless material increases the power required for grinding. It may, however, easily be found, in places where the cost of transport does not call for consideration, that coal having a high percentage of ash can be used with advantage on account of the low price at which it can be purchased. The moisture in the coal is converted into vapour by the heat generated in the pulverising process, and the vapour is blown into the combustion chamber. It is therefore advisable to get the moisture content low, and if the coal received contains an undue proportion of moisture it is well to allow it to stand for a day or so under cover. No trouble is experienced, however, in dealing with coals containing an average amount of moisture, for no powdered coal is stored and the coal does not pass through fine screens. The fuel used in connection with the plant shown in Fig. 3 is "Lumbley No. 3 splints," which is so difficult to burn in solid form that there is little market for it. One-third part of this part class of fuel can be burnt when it is mixed with two-thirds of better class of fuel. The resultant ash from this mixed coal, burnt uncrushed, contains from 25 to 30 per cent. of unburnt carbon, whereas the ash from the powdered fuel is practically devoid of unburnt carbon. The analysis of the "splint" coal is as follows:—Volatile content, 23.10 per cent.; fixed carbon, 47.38 per cent.; ash, 26.56 per cent.; moisture, 2.96 per cent.; calorific value dry, 10,650 B.Th.U.; wet, 10,340 B.Th.U.

The average $CO_2$ content in the gases of combustion was 16.4, and although on several occasions CO was looked for, none was found. The average $CO_2$ content is so high that the accuracy of the analysis was questioned, but repeated tests indicated that the high percentage of $CO_2$ given by the pulverised fuel boilers was correct. No actual figures for evaporation or fuel consumption are yet available, as the boiler worked with the pulverised fuel operates on a common main with other boilers.

FIG. 3—BABCOCK MARINE TYPE BOILER FITTED FOR PULVERISED FUEL

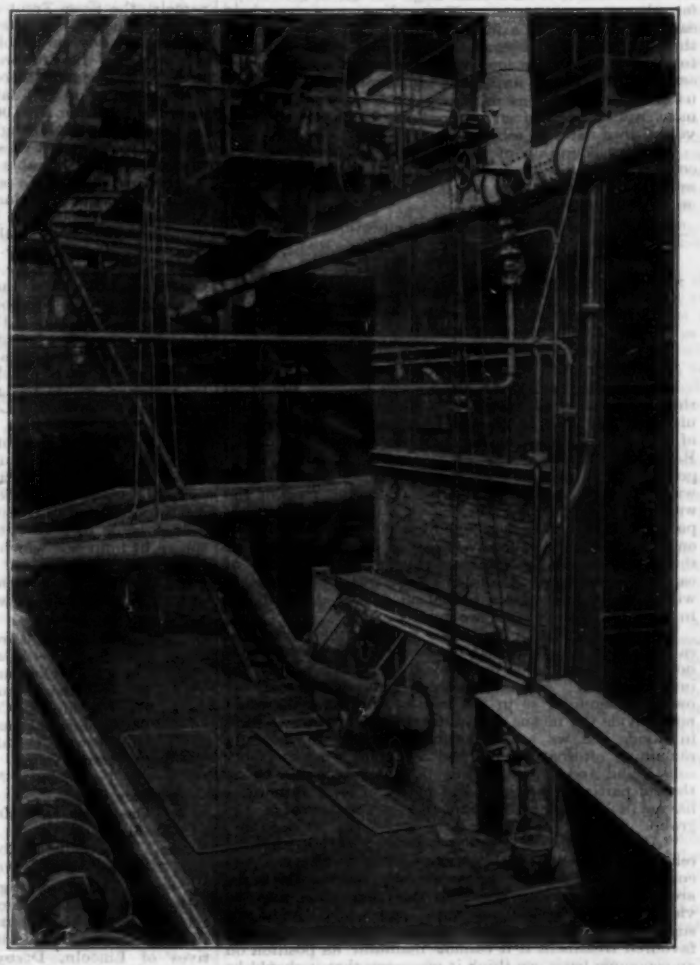

FIG. 4—THOMSON BOILER FITTED FOR PULVERISED FUEL

## Second Interim Report of the Committee on Inland Waterways.

In February last the Committee on Inland Waterways, appointed by the Ministry of Transport, which consists of Mr. Neville Chamberlain (chairman), Sir William M. Acworth, Mr. Ernest Bevin, Mr. R. B. Dunwoody, Sir John E. Eaglesome, K.C.M.G., Sir Noel T. Kershaw, K.C.B., and Sir Halford J. Mackinder, with Mr. Arthur Sharp, as secretary, presented to Sir Eric Geddes a first interim report. It has, during the past week, presented a second interim report. The first report dealt with the proposed improvement of the river Trent between Newark and Nottingham, and indicated that the Committee might have further proposals to put forward in connection with that river, and embracing the whole water route between the Midlands and the Humber ports. In the present document, it is explained that, though it has not yet worked out all the detail of its plan, the Committee is of opinion that the introduction of the Railways Bill makes it desirable that it should immediately lay before the Ministry the broad outlines of the policy with regard to canals which it considers should be followed in the future. The Committee remarks that the Bill provides for a great strengthening of the railways of this country by amalgamating them into groups, and says that it appears to it necessary that the future of the other forms of transport should be considered and, if necessary, safeguarded at this critical stage. It accordingly reports as follows:—

"When comparing the traffic carried by inland waterways and railways respectively, it must always be remembered that even those water routes which connect the great ports with important industrial centres inland, are generally divided into sections belonging to different owners. As a rule, these owners are not themselves carriers, but merely toll-takers, and consequently there is no regular service, no attempt to attract traffic and generally very indifferent means of handling such goods as are carried by the bye-traders.

"It was the consideration of these facts which led the Royal Commission of 1906 to the conclusion that the first essential to progress was unification of ownership, and their principal recommendation was that the unification should be achieved by progressively substituting the State for the existing owners of the waterway system known as 'the Cross.' Their recommendations were not adopted, possibly owing to the magnitude of the operations involved in improving the whole of 'the Cross,' and since the

report was issued, not only have the waterways themselves further deteriorated, but the change of values brought about by the war has made it useless to put forward any scheme upon such a basis.

"Nevertheless, we are convinced that certain important waterways, were they given a fair chance and put under unified and competent management, would be capable of playing a very important part in the transport of the country. Experience shows that for certain kinds of traffic, water transport can more than hold its own with other methods, and in this connection it may be pointed out that where river craft can load direct to or from a ship lying in an estuary, lighterage, dock and warehousing charges are avoided.

"In our last report we gave reasons for not putting forward estimates of increased traffic or revenue to be obtained from unified improved waterways. Such estimates are bound, in the present state of our knowledge, to be speculative and unreliable, and any deductions based upon them would lack authority. If any progress is to be made, it will be necessary to take some risks, but we are of the opinion that it is possible to proceed by steps, the first of which would be comparatively inexpensive, but would afford data on which to found further advance if the results justified anticipation.

"It is clear that no experiment can be expected to succeed unless it is on a scale large enough to give scope for adequate management. Nationalisation of our whole canal system we put aside as involving liabilities greater than the nation is prepared to face, but if it were possible to divide up the various waterways into groups, each centring round some important traffic route, it appears to us that the conditions necessary for a successful experiment would be attained without incurring the risks involved in a national scheme.

"On consideration of the principal waterways of the country, they seem naturally to arrange themselves into seven groups or systems, which may be roughly described as follows:—

(1) The river Trent and its connections.
(2) The Yorkshire canals.
(3) The Lancashire canals.
(4) The canals joining Liverpool with the Midlands.
(5) The river Severn with its connections.
(6) The river Thames and its connections with the Midlands and Bristol.
(7) The Birmingham Canal and its connections in Midlands

"The policy which we recommend as best suited to the needs and conditions of the times, contemplates the ultimate fusion of all the waterway connections in each of these groups into a single ownership, just as in the Railways Bill six groups of amalgamated railways are proposed. But whereas the railway position is established with adequate staff, equipment and capital, that of the waterways is still uncertain and precarious, and our proposal, therefore, is that a beginning should be made with one or two only of the groups, selecting those which present the best prospect of success with the least amount of capital expenditure. The other groups would be proceeded with if and when their formation appeared justifiable in the light of the experience gained.

"There is a further difference between the position of railways and canals in that the credit of the latter would not be sufficiently good to enable them to raise capital for improvements. A mere amalgamation of the existing owners, therefore, as in the case of the railways, would not provide the means of making the experiment we have in mind, and we are, accordingly, driven to the only remaining alternative, namely, a public trust, suitably constituted and supplementing its financial resources by the aid partly of the State and partly of local authorities having a special interest in the development of the group.

"At this point it becomes necessary to consider the relations between such a waterway group as we have been contemplating and the railway group serving the same area. The waterway group in this connection may be viewed as a 'nascent industry,' and while we do not suggest that it should permanently receive specially favoured treatment if it cannot maintain its position on an economic basis, we think it necessary that it should be protected from unfair competition during its earlier years. We have had evidence that in the past railway companies have, in order to meet water competition, not merely quoted special and uneconomic rates, but that they have even given free lighterage, cartage and warehouse accommodation. This course of action may be compared to the 'dumping' of which manufacturers complain, and since in this case the result would be to ruin the enterprise before it had proved whether it could stand on its own legs or not, we consider it essential that special concessions, either in rates or conditions, given for the purpose of crushing out water competition, should be barred by statute. In this matter, inland waterway traffic and coastwise traffic stand together, and the necessary provisions should be inserted in the Bill now before Parliament.

"In order to carry through the grouping system which we are proposing, it would be necessary to be able to bring in all the waterway connections comprised in any group, even though the trust, when formed, might find it desirable to close certain branches. It follows, therefore, that the trust must have the power of taking over any canals owned or controlled by railways within its area, and we consider that a clause should be inserted in the Railways Bill providing that, in the case of any Bill or Order proposing to transfer a canal or waterway owned or controlled by a railway company to a body of trustees or commissioners to be constituted by Parliament, the railway company shall not be entitled to be heard in opposition, except upon the terms of the transfer.

"Returning now to the proposed public trusts, we contemplate that these should take the form of a statutory body composed of representatives of the Ministry of Transport, the local authorities of the area covered by the group, users of the waterways, Chambers of Commerce and the stockholders. The latter would comprise the original owners of the various waterways in the group, who would receive trust stock in return for their interest, and also subscribers to the capital of the trust, whether in the form of debentures or of preferred or deferred stock. It is proposed that local authorities should be represented as such, but additional representatives would be appointed to the board in proportion to capital subscribed.

"While we do not desire to give the trust a monopoly of carriage on its own waterways, we consider it essential that it should have power to carry and to conduct the business of carriers, including the provision of proper equipment, the soliciting of traffic, &c. The rates charged would be governed by competition, but the tolls to be charged to bye-traders would be fixed under statutory conditions. Further, the trust should have power to apply under Clause 42 of the Railways Bill for through rates on traffic to be forwarded partly by water and partly by rail, and provision should also be made for the fixing of through tolls where traffic is to be forwarded wholly by water but partly over routes not included in the area of the trust. The trust must also have power to purchase land compulsorily for widening existing waterways or for the construction of new works, and we consider that these powers should extend to the purchase of land adjoining the waterways up to a statutory distance, so as to give the trust the benefit of any appreciation of frontage values in consequence of its operations. Finally, the powers of the trust should include the acquisition by agreement of land beyond the statutory distance.

"Reverting to the various groups suggested in paragraph 7, the one which we have put at the head of the list, namely, the river Trent and its connections, stands out as pre-eminently suitable for the first experiment. The river is already navigable for 120-ton barges as far as Newark, and the Corporation of Nottingham is under a statutory obligation to carry out certain improvements, which, even at present-day costs, would involve an expenditure of less than £500,000, and would enable these craft to go right up to Nottingham.

"In our last report we set forth our reasons for believing that a very considerable increase of traffic would follow this improvement. We pointed out that although Newark itself is not a great originating source of traffic, the execution of the works which brought it within reach of craft capable of navigating the Humber at once induced a great accession of water-borne traffic; so that the final completion of the water connection between a first-class port like Hull and so important an industrial centre as Nottingham might reasonably be expected to show far greater results. But if the various water connections of the river were also brought under a unified management and regular services established, we can see possibilities of very much larger development. The Foss Dyke Canal, for instance, would bring in the large works established in the neighbourhood of Lincoln, and we have had evidence to show that, even now, a certain amount of trade goes by this route, in spite of the inadequate locking accommodation. We do not suggest that it would be necessary to include all the eventual elements of the trust at its commencement, and indeed it would simplify procedure if it were limited in its scope to begin with, but we think it is possible to map out the area to be included in the sphere of influence which might ultimately be taken into its control.

"Accordingly, we propose that the following waterways should be regarded as within the 'sphere of influence' of the proposed trust:—

The River Trent from Trent Junction to Keadby.
The Chesterfield Canal.
The Foss Dyke Canal.
The Grantham Canal.
The Nottingham Canal.
The Cromford Canal.
The Erewash Canal.
The Derby Canal.
The Trent from Nottingham to the Trent and Mersey Canal.
The Trent and Mersey Canal from the Trent to Fradley Junction.
The Loughborough Navigation.
The Leicester Navigation.

"Some further investigation would probably be necessary before deciding which of these waterways should be acquired by the trust, but we think it should be considered whether the original trust should not include representatives of Lincoln, Derby, Burton, Loughborough and Leicester, even though the navigations and canals with which they are particularly concerned do not come within its original scope.

"We may now recapitulate our suggestions and proposals so far as they are expressed in this report.

"Before the war, canals and inland waterways carried some 40 million tons of traffic annually, with profit to themselves and advantage to the public. The altered conditions of the present day have, at any rate for the time being, placed them at a serious disadvantage, but it is quite certain that traders do not desire to see them become derelict if it is at all possible to carry on their business on an economic basis.

"To achieve this, it is necessary as a first step to bring about unification of ownership, and, nationalisation being out of the question, we propose the only practicable alternative, namely, the amalgamation of the various undertakings into a series of groups. For financial reasons, it seems impossible to leave these groups purely to private enterprise, and, accordingly, we propose that they should be owned and administered by public trusts, limited as to dividends and financed wholly or partly by the State and the local authorities concerned. These trusts would be composed of representatives of various bodies having interest, financial or otherwise, in the working of the waterway system, and they would have power to act as carriers as well as toll-takers from bye-traders. In order to facilitate their formation, we suggest that a clause should be inserted in the Railways Bill providing for the transfer to the trust by the railways, as and when required, of any railway-owned or controlled canals on terms to be set forth in the Bill. We also consider that provisions should be inserted in the Bill which would make it impossible for any railway group to quote rates or to give special services free of charge for the purpose of crushing out competition by a waterway trust in its area.

"We desire to make it clear that we do not contemplate the immediate setting up of trusts to deal with all the seven groups into which we suggest that the principal waterways of the country should be amalgamated. On the contrary, we propose that the process should go forward by steps, beginning with those groups which offer the best prospects of a return with a minimum of expenditure. In our opinion, the river Trent and its connections offers unique advantages in this respect, and we urge that the formation of a Trent Trust should be proceeded with at the earliest possible moment."

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The report was signed by all the members, saving Mr. Ernest Bevin, who was unable to assist in the deliberations of the Committee upon this report, but who wishes it to be placed on record that he dissents from the conclusions of the Committee with regard to ownership and control, being of the opinion that nothing short of national ownership of the waterways of the country is likely to secure their full utilisation or proper development. Sir William M. Acworth signed the report subject to the reservations appended hereto.

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RESERVATIONS BY SIR WILLIAM M. ACWORTH.

"(1) I have hesitated whether I should sign the above report. I agree with my colleagues on most points. I differ on others, which seem to me more important. My signature must therefore be taken with the reservations which I make below.

"(2) I agree that canal development is not possible unless the whole of the waterways within the same geographic and economic area are brought under unified control, and that with this object railway companies should be required to surrender any canal properties they may own within such an area. I agree that the canal owner must be permitted to be also a canal carrier. I agree, further, that, if an experiment is to be made at this stage, it should be on a modest scale: that the Trent basin offers the best field for such an experiment, and that the proposed expenditure of £500,000 in order to enable 120-ton barges to reach Nottingham may fairly be described as modest. But at this point I am reluctantly compelled to part company. I think that an experiment at this moment would be premature.

"(3) Experiment means an advance from the known to the unknown. An advance into the unknown future should not be made till the relevant facts of the past and the present have been ascertained with such accuracy and completeness as is possible. I do not think this has yet been done. I will indicate very briefly two lines of investigation which, in my judgment, should be further explored before embarking upon an expenditure even of £500,000. There is evidence obtainable from other countries which is, in my judgment, relevant to the question how far traffic on artificial waterways in a district fully provided with railways has an economic future. The State of New York has spent in the last twenty years about £25,000,000 sterling on the improvement of the Erie Canal. This Canal occupies a route of traffic as dense as anywhere in the world. It is capable, I believe, of accommodating barges of 800 or 1000 tons, and yet from such information as I have been able to obtain privately, I gather that the Canal is almost empty, and that the traffic continues to flow by rail. There was before the war an enormous volume of traffic carried on the Rhine. I have recently seen in the German technical Press lamentations from the Rhine shipping interests that, under changed economic and political conditions, a large proportion of that traffic has been diverted to the railways. I mention these two instances—there may be many more—where I think investigation should have been made as a guide in estimating future probabilities in this country. If it be true that the Erie Canal is failing to obtain and the Rhine is ceasing to hold traffic in face of railway competition, there must be reasons. I think we should ascertain what they are. Whether American and German experience will have any lessons for us, we cannot say till we know what the experience is. But *a priori*, if the Erie Canal and the Rhine cannot hold their own against railways, the chance of success seems small for a canal capable only of accommodating 120-ton barges.

"(4) In this country also, I think further investigation should be made before we embark on experiments. I think the Statistical Department of the Ministry would be able to give, if called upon, an approximate estimate of the volume and composition of the traffic in the basin of the Trent, and that these figures might afford an approximate idea of the amount possibly available for canal carriage. I believe, further, that an estimate—rough, I admit, and provisional—could be made of the actual out-of-pocket cost of carrying traffic of different kinds in 120-ton barges between, say, Hull and Goole, on the one hand, and Nottingham, on the other. A comparison of these costs with the existing railway rates for similar traffics would afford at least some indication of the maximum possible inducement that there would be for traders to transfer their trade from the railways to the waterway. There would then be at least some data available on which to calculate the level at which tolls could be economically fixed, and the possible revenue to be derived therefrom. I assume it will be agreed that if, for instance, the proposed improvement costs, adding together interest on capital and current maintenance charges, £50,000 per annum, while traders, by using the canal instead of railways, made a saving of £25,000 per annum, the scheme would not be economically justifiable. If, on the other hand, the saving to the traders was £100,000, the position would be reversed.

"(5) I have one further point of disagreement. If the proposed experiment is to be tried, I agree that the local authorities along the route should be permitted to subscribe towards the cost, if they desire to do so. But, except so far as the Government is already pledged, I do not think any contribution should be made by the State. Under the Railways Bill now before Parliament, there will be in the east of England a single railway group extending from the Thames to the Tweed. The Bill provides that the rates chargeable within the group shall be so adjusted as to produce a certain net revenue for the railway shareholders. If the improvement of the waterway were to result in substantial diversion of profitable traffic from the railways in the Trent basin, the railway rates in East Anglia or Northumberland might be put up to meet the deficit. The inhabitants of the Trent Valley are quite entitled to spend their own money for their own advantage. But it is not just that the State should intervene to help one district at the expense of others."

"(Signed) W. M. ACWORTH."

## Railway Matters.

THE railwaymen's guaranteed week, suspended, as from May 2nd, in favour of a three-days per week guarantee, was restored on the 8th instant, in view of the settlement of the coal dispute.

IT was announced in Parliament on June 28th that the London Electric Railways Company will have, in accordance with a clause in the Act of 1920, to submit a financial statement at the end of the half-year to show that the increase in fares made last year continues to be justified.

INFORMATION has reached Paris that the Rumanian Government is in negotiation with two German locomotive works, the Lincke-Hoffmann and Krupps, for the supply of locomotives to Rumania. It is understood that the two firms will receive an order for railway engines up to the value of 500,000,000 marks.

IN a circular to the staff of the Pennsylvania Railroad, General Atterbury, the vice-president, said that there were three "musts" that the company and its servants will have to work out in co-operation. First, the public must have efficient and economical service. Secondly, the officers and the employees must be paid good wages in return for good service rendered. Thirdly, the company must earn a reasonable return on the capital invested in the property.

IN the debate in Committee B on the Railways Bill on July 7th a proposal was made to insert powers to buy up the privately owned wagons. Sir Eric Geddes opposed this, but said he adhered to what he had formerly said about the advantages of abolishing the private ownership of railway wagons. But on going into the matter since he had found so many diverse types, and that such complications would arise if they were repaired broadcast throughout the country that more would be lost than gained.

ABOUT 95,000 tons of new steel rails and 5,300,000 new sleepers were used by the Pennsylvania Railway last year. Of the 95,000 tons of new rails, 82,500 tons, or 87 per cent., weighed 130 lb. per yard. The use of heavier than 100 lb. rail was begun in 1915. Steel rails for 1920 use cost approximately 48 dols. a ton, an increase of 8 dols., or 20 per cent. over the previous year's cost and 63 per cent. more than the cost of rails ten years ago. Sleepers cost 32 per cent. more than in 1919 and 153 per cent. more than ten years ago.

THE city of Boston, Mass., has two fine stations, the North and the South, the latter being quite modern. The North station has twenty-three platform lines. Six of these lines belonged to the original Boston and Lowell station, built in 1872, and the other seventeen were provided for the Boston and Maine in 1893–94. The roof over the former was designed after the Midland Company's London terminus at St. Pancras, having an arch of a span of 110ft., and 63ft. high at the crown. The roof over the later part of the station was simply nine spans of roof trusses. Both roofs have only recently been removed and replaced by umbrella roofing.

WHEN the North Staffordshire Railway Bill was in Committee in the House of Commons a clause, intended to legalise the long standing practice of the company to supply water from its canal to traders, was opposed, but was passed with certain limitations. These limitations were, however, made general instead of being confined to the locality represented by the petitioners against the clause. In Committee in the Lords on the 4th instant this was adjusted, and water may be supplied anywhere, except that, in the area of the Staffordshire Potteries Water Company, the consent of that company must be obtained, for condensation or boiler purposes or the washing of coal or coke.

THE claim of the North British Railway Company against the Ministry of Transport, referred to in a leading article in our issue of July 1st, remains unpaid, as an appeal against the decision of the Railway and Canal Commission has been lodged. Now, not only is there the initial deduction of £430,000 for last December, but there are further reductions, amounting in the aggregate to £550,000 for the first five months of this year. The summer session of the First Division of the Court of Session closed on the 20th instant, so counsel for the railway company asked on the 9th that the appeal might be accelerated, seeing that dividends were being withheld. The request was refused and the case cannot be considered until October.

SUCH an unfortunate occurrence as that of July 8th, on the East London Railway, when four wagons broke away and ran back down a gradient of 1 in 40, is generally met by the provision of runaway catch points. These consist of a switch in the left-hand rail, which becomes facing to a runaway wagon and throws it off the line. In ordinary running the point is a trailing one, and each wheel closes the switch against a spring, so that after the wheel has passed the switch automatically opens. The presence of the live and return rails of the electric traction interfere with the insertion of such runaway points, and this probably accounts for their absence from this particular falling gradient. Since the electrification of the East London was completed in 1913 the Ealing and Shepherd's Bush line has been built and there is a runaway catch point, although there are third and fourth rails.

IN debating Sub-sec. 2 (*b*) of Clause 12 of the Railways Bill as to co-operative working or common user of rolling stock, workshops, manufactories, plant, and other facilities, the question was asked as to the effect of the clause on the smaller railway workshops. This gave Sir Eric Geddes an opportunity to observe that he did not think that the clause gave the Minister power to close any workshop. As a whole the railway-owned shops of the country were inadequate to the demands on them. The only reason for this provision was to ensure that where a railway had any surplus repair facilities they should be used in the general interest. If, as he believed, there was within the next ten years a considerable transfer of ownership of rolling stock from traders to the companies that would throw more work into the railway shops. It was accordingly extremely unlikely that any shop which was even moderately equipped would be closed.

## Notes and Memoranda.

THE disadvantages of highly polished surfaces on motor cars are pointed out in a short article in the *Autocar*. Not only do they entail much labour in cleaning, but they also often produce disconcerting and dazzling reflections.

A MEMORIAL tablet has just been placed on the house, 31, High-street, Hythe, where Sir Francis Pettit Smith, one of the early inventors in connection with the marine screw propeller, was born in 1808. His first patent was taken out in 1836.

GEOLOGISTS who have explored Peru under Government auspices have reported great oil deposits in the Montana or forest region on the eastern slops of the Andes. The coast from Port Tumbez to Ilo, which is said to be rich in oil, as are also the hills at 8000ft. to 15,000ft. above sea level. Oil has also been found in the Departments of Abancay and Ayacucho.

AN article in the *Engineering News Record* of June 16th describes the merits of a plastic form of gypsum for plastering purposes. The material is prepared by fine grinding in such conditions that the water of crystallisation is liberated, but yet is not permitted to escape from the system. Calcined gypsum thus prepared is said to be more plastic than lime.

THERE are many favourable things that can be said about Canada's oilfields, according to Mr. T. M. Buley, of Toronto. The shallowness of the wells is a particularly outstanding feature of the oil regions in Western Canada. The fact that drilling has only to be done for a distance of 700ft. to 800ft., compared with 5100ft. in California, will prove a very important factor.

IT has been estimated that the quantity of timber, other than teak, standing in the forests of Burma, and comprising trees 3ft. in girth and over, amounts to over 584 million tons, of which 110 million tons consists of pyinkado. The pyinkado, or iron wood (*Xylia dolabriformis*) is of a reddish brown colour, extremely hard, strong, heavy and durable, and extensively used for railway sleepers and constructional work of all kinds.

IN discussing a paper on "Powdered Fuel," read before the South Wales Institute of Engineers by Mr. R. James, Professor F. Bacon asked: "Is it not largely a fallacy to think that because you have turned out your fire you have thereby eliminated banking losses? Your boiler remains hot and radiation losses continue all the night long and all Sunday, and the heat lost in this way has got to be made good again before you can get back to normal steaming conditions."

IN a recent correspondence in *Nature* on the subject of picture-hanging wire, copper or brass wire has been recommended. Mr. N. M. Richardson now writes to our contemporary, however, to condemn such materials for the purpose on account of the brittleness which develops in the course of a few years. He advises the use of galvanised iron wire, which can be painted a suitable colour if desired. Such wire has been found to be very trustworthy and permanent unless it is exposed to damp.

SOME unexpected difficulties which were experienced in filling in some high viaducts on the Philadelphia and Reading Railway are described in the *Engineering News Record*. In one case the steel trestle was 129ft. high, and when the spoil had been tipped round it to a height of about 50ft. the structure began to lose shape. So the railway was supported on temporary timber work and the legs of the original trestle separated at the top from the superstructure. Filling was then proceeded with and it was found that the free top ends of the trestle legs moved away from their original positions as much as 6ft. in some cases, showing that they had been badly distorted by pressure from the filling material.

IT is highly probable, according to the *Chemical Trades Journal*, that the demand for china clay will be enormously increased by reason of the discovery of colloidal clay, as there are many industries that can use colloidal clay which cannot use the ordinary china clay. The soap industry will be largely affected, as it is now possible to make soap with colloidal clay instead of oils, and as palm oil has fluctuated in recent years from £60 to £100 a ton and colloidal clay can be produced at £3 to £4 a ton, a great saving should result. Another industry likely to be affected is that of paint. Up to the present it has not been possible to use china clay in the making of paint, but the future holds out great possibilities in this direction.

AN improved form of oxy-acetylene torch has, according to *La Nature*, been evolved in the French Navy in the process of salving vessels lost during the war. A small bell-shaped vessel surrounds the oxy-acetylene flame, and is kept supplied with compressed air. After the flame is alight and the stream of compressed air established the torch may be plunged into water without being extinguished. If by accident the original form of blow-pipe was extinguished, it was necessary for the diver to ascend to the air to light it again. A tube containing an alkaline metal and an oxidiser is now attached to the torch, and can be moved to the mouth of the bell. On removing the cap from the end of the tube the chemical action of the water on the mixture produces a flame which re-lights the torch. The addition has greatly increased the number of underwater uses to which the torch can be put.

MINERS' phthisis is produced by the mechanical irritation of the lungs by particles of dust of rock containing free silica. The dust is dangerous in proportion to the amount of free silica or other hard, sharp, insoluble material it contains, and the particles of dust small enough to enter and remain in the lungs measure less than $^1/_{200}$in. in longest dimension. Miners' consumption is mechanically produced, is neither contagious nor infectious, develops slowly, and by the production of scar tissue gradually impairs the function of the lungs. The length of time necessary to produce the disease depends on the length of time the miner has worked in rock yielding hard, sharp, insoluble dust, the amount of silica in the dust to which he has been exposed, the steadiness with which he worked, the intensity of application of the man to his work, the actual nature of the work he has done underground, and to a great extent on the general conditions under which he works.

## Miscellanea.

A FACTORY for working up asbestos is to be erected in Quebec at a cost of nearly £500,000.

THE proposal to establish telephone connection between Madras and Ootacamund has been put off till next year.

THE reasons for British trade success in engineering products in the Chinese market are to be made the subject of special study by a party of five hundred American engineers, who are to visit that country towards the end of this year or in the early part of 1922.

THE Kunda river scheme, which was to provide sufficient power for Ootacamund, Coonoor, Wellington and Coimbatore is in abeyance, but pending the introduction of this comprehensive scheme it has been suggested, according to *Indian Engineering*, that a temporary plant may be installed for providing the requisite power and light.

A COMPANY has been formed at Granada under the name of "Sociedad Anonima Fuerzas Motrices del Valle de Lecrin," which proposes to erect and work hydro-electric power stations in the Valle de Lecrin. The first station is to be constructed on the river Durcal, where 4000 horse-power will be developed by a fall of 758 m.

THE new Australian Navigation Act, which will come into operation on October 1st next, requires that every foreign-going or Australian trade ship, and every ship engaged in the coasting trade, which carries more than twelve passengers, or which, in the case of other ships, is of 1000 tons gross tonnage or upwards, shall carry wireless apparatus as well as operators and watchers, unless specially exempted from doing so.

THE official conditions governing the tractor competitions which are to be held under the auspices of the Turkish Ministry of Agriculture in September next near the factory of Zaiton Bournou have been received from the Commercial Secretary to the British High Commission at Constantinople, and may be inspected by United Kingdom firms interested on application at the Inquiry Room of the Department of Overseas Trade, 35, Old Queen-street, Westminster, S.W. 1.

A SERVICE of pilots for motorists unfamiliar with the metropolitan area was instituted a short time back by the Automobile Association. The pilots meet motorists at pre-arranged points on the outskirts of London, or—in the case of members of the Association arriving with their cars at the Port of London—down at the docks, and pilot them by the best routes, avoiding traffic and so forth, either across London—to where traffic difficulties cease—or to any point in London itself.

THE Paris *Journée Industrielle* reports the holding at Wattignies-lès-Lille of the first public trials of mechanical flax-pulling machines to be carried out in France. Only two machines took part, one belonging to Marshall, Sons, and Co., Limited, of Gainsborough, and the other to the Push-Tombyll firm, the two machines being built on entirely different principles. There was an attendance of over 1000 visitors, both French and foreign, and the trials are reported to have been successful. Each machine received a prize of 5000*f*.

ONE of the San Francisco real estate firms has announced the fact that it has arranged for the necessary capital with which to construct a 25,000,000 dol. bridge from Candlestick Point near South San Francisco—about 6 miles in an air line south of the Ferry Building—to a corresponding point on the Alameda side of the bay. The structure would be designed for steam and electric lines, as well as for vehicular traffic, and would have a bascule span to permit the passage of shipping. The construction is estimated to require three to four years.

THE annual general meeting of the General Electric Company, which was held on July 21st, was made the occasion for a "house-warming" at the new offices, Magnet House, Kingsway, W.C. 2, which have just been completed. One of the most striking features of the new building, as compared with the old establishment in Queen Victoria-street, is the disposition of the show-rooms and sales counters. The latter are very conveniently arranged as concerns both the customers and attendants, and are equipped with a belt conveyor for taking customers' purchases to the packing department.

THE new Kidderpore bridge which is now being built in Howrah will be one of the finest road bridges in India. The bridge will be a bowstring truss with a clear span of 237ft. and an overall width of about 87ft. The structure will consist of two main girders spaced 40ft. centres, having between them a roadway 30ft. wide to accommodate two lines of trams down the centre and a road for fast and heavy motor traffic on each side of the tramways. On either side, outside the main girders, there will be cantilevered out a roadway for slow traffic 8ft. wide. Footpaths 10ft. wide will be supported by the outer ends of these cantilevers.

CONSIDERABLE interest is being taken in Paris in a congress which is now being held at Munich, the object of which is the furtherance of an extensive scheme for opening up a waterway between the North Sea and the Black Sea. The German Central Company for River Navigation, the Main-Danube Union and the German-Austrian-Hungarian-Swiss Union for River Navigation are discussing the details of this scheme, according to which it is proposed to utilise the Rhine, Main and Danube so as to provide a means of transit by water from North-Western to South-Eastern Europe. The opening sitting of the congress was presided over by Herr Hugo Stinnes.

IN the course of the debate by the Budget Committee of the Bavarian Diet on the Main Danube Canal scheme on July 15th, the Government representative declared that Bavaria and the Empire, with the help of third parties, should participate in the undertaking. The Government confidently anticipated that the canal would be a paying concern. It was calculated that the construction works would be completed as far as Nuremburg in eleven years at a cost of 9,700,000,000 marks. A share capital of two hundred and fifty millions with a bond issue to the amount of six hundred millions was contemplated for the present. A favourable return was expected from the projected waterways at the end of three or four years.

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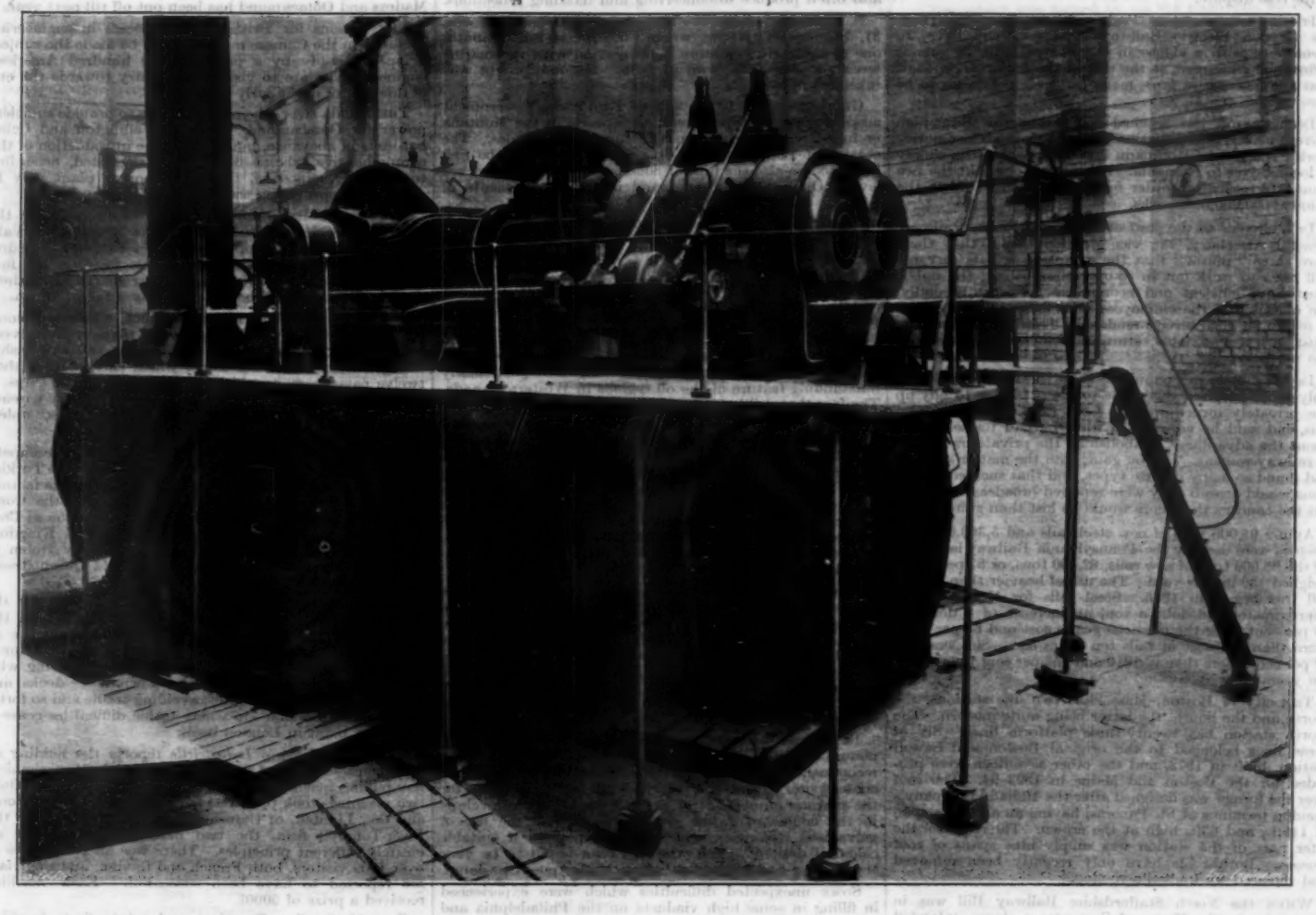
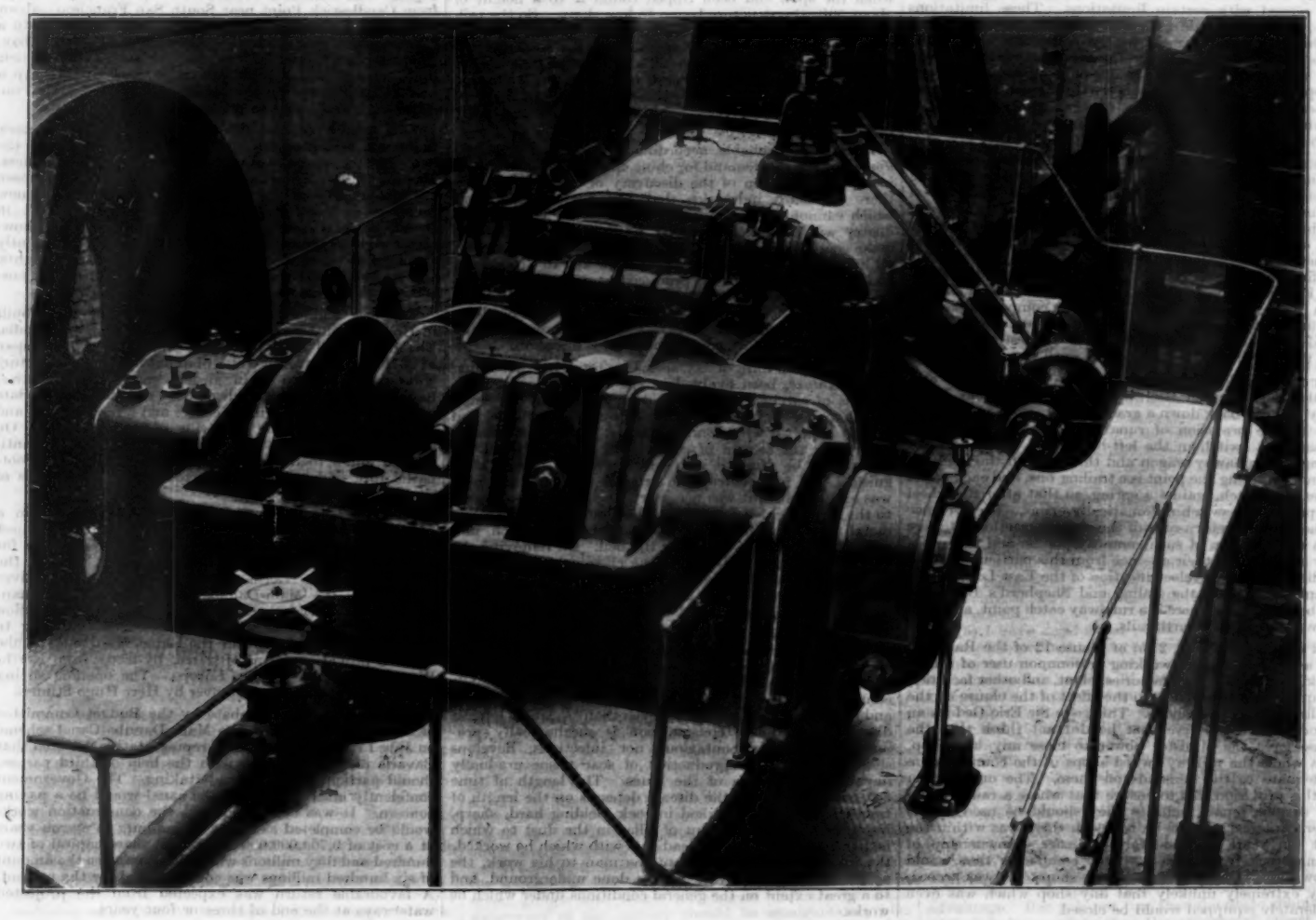
ROBEY AND CO., LIMITED, LINCOLN, ENGINEERS

(*For description see page 88*)





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TWO-PAGE SUPPLEMENT—500 H.P. COMBINED ENGINE AND BOILER.



# THE ENGINEER.

*JULY 22, 1921.*


### The Heat-Treatment of Steel.

THAT the physical properties of steel can be profoundly modified and improved by proper thermal treatment is a fact which engineer and metallurgist alike have the fullest ground for recognising. It not only emerges most clearly from every laboratory research on steel, but its truth has been amply confirmed on the largest scale industrial practice. In the construction of the aeroplane and the automobile particularly, the use of heat-treated steel could not be dispensed with unless greatly increased weight and diminished efficiency were to be incurred. It is not unreasonable to ask whether the use of heat treatment is as widely applied to other branches of steel construction and, if it is not, to look into the causes which are at work to prevent such an application.

Broadly speaking, it must be admitted that no attempt is made to apply heat treatment to the great bulk of steel used for constructional work. A few exceptions may be cited, such as the production of "sorbitic" tires and rails by a special process, in which the cooling of the steel is specially accelerated. But the proportion of rails and tires to which such treatment is applied is by no means large. Another example is the "*in situ*" hardening of the surfaces of tramway rails by a process which, although at first sight it seems to be a metallurgical barbarity, yet appears to give valuable results in certain situations. But the very paucity of such examples serves to show that the great bulk of steel is used in a "crude" state and without any serious attempt to bring it into its best condition. Nor need we look far for the motives which lead to this neglect of heat treatment and its great possibilities. In the first place, it is believed that heat treatment is too costly to be widely applied to the cheaper grades of steel. It is regarded as being well worth while in an expensive alloy steel, but not for ordinary grades of material. In the second place, it is still believed by many that ordinary carbon steel does not respond adequately to heat treatment, and that it is not only expensive, but useless and unnecessary to attempt heat treatment with ordinary carbon steels. After all, it is said, steel can be got "strong enough without." While there is a certain amount of force in the first argument—that of cost—there is none in the others, and the cost is mainly a question of the real relative values of the treated and the untreated steel. When steel was very cheap—in the "good old days" before 1914—there was perhaps less need to consider ways and means of using it to the best advantage. Now, however, when the material is relatively very dear, the question of using it to best advantage becomes much more important; and yet there is considerable reluctance to take the trouble to get it into its best condition. That ordinary carbon steel can, and does, respond to heat treatment to a degree which makes a very considerable difference to its structural value cannot now be denied. In fact, careful and expert heat treatment of carbon steels is capable of producing results which only the best of the alloy steels can materially surpass. But it is not merely a question of producing a material having a higher elastic limit and tensile strength or even a higher impact test figure; one of the main points about heat treatment is that it furnishes the engineer with a more reliable material, in a definite structural state. This point may be explained by a simple example. If a certain combination of tensile strength and ductility is demanded under a specification, it is possible for the steel maker to meet it in several ways. One way, and the only really satisfactory way, is by supplying a steel of such chemical composition—mainly as regards carbon content—as will, in its best condition, satisfy the tests. Here we are not referring to any re-heating and cooling or quenching and tempering, but to that simplest form of heat treatment which consists in nothing more than finishing the steel at the right temperature and, if necessary, regulating its subsequent rate of cooling. Another method open to the manufacturer, however, consists in utilising a steel of higher carbon content which in its really best condition would be too hard to satisfy the specification. It can then be softened by suitable annealing at a relatively low temperature, and when thus treated will meet the ordinary tensile tests specified. But it cannot be regarded as truly satisfactory material, although many tons of such steel are used every day. Such softened steel has a relatively very low elastic limit—meaning thereby the limit of proportionality and not the "yield point"—while its power of resisting fatigue is also considerably less than it should be.

It must, of course, be recognised that if the steel maker were confronted with specification clauses restricting his treatment of the steel to really correct heat treatment or finishing operations, he would be put in a difficulty in meeting narrow specifications. It is not, perhaps, too much to ask of his skill and technology, in these days of advanced metallurgical practice, that he should supply steels of the right chemical composition even within the narrow limits which would thus become obligatory. If this is truly asking too much, then it would be better to face the facts and to widen our specifications to admit of steels within such limits of composition as the manufacturer can be expected to maintain. We do admit such steels now, but there is a certain amount of self-deception in using them in the "softened" state. They appear to be more ductile and "safer" than in their harder condition, but in reality they are not so safe and reliable. We do not wish to suggest that it would be advisable to attempt the application of elaborate quenching and tempering operations to the more ordinary grades of steel, but simple "normalising" or even closer attention to finishing temperatures and final rates of cooling would suffice to eliminate a large amount of material which at present finds its way into use in a condition of internal structure which is known to be far removed from the most satisfactory and reliable state. It is for the engineer to see that he obtains his steel in the best possible state, and for the skill of the metallurgist to supply it to him in that state.

### As Others See Us.

MR. E. J. P. BENN and Mr. F. Elliott went to the United States with letters of introduction from the Industrial League and Council. They stopped there thirty-five days, and last week the League entertained them at a complimentary dinner. After dinner they told the League what they thought of America, and drew from their experiences pointed lessons for the industrialists of this country. It is probable that Mr. Benn and Mr. Elliott crossed the Atlantic nursing certain prejudices. No one ever starts on an excursion of this kind with a perfectly open mind. They wanted to see those aspects of American industrial life that could be "rubbed in" to Englishmen when they got back home. They did not, we are pretty sure, intend to form a perfectly balanced opinion on the industrial life of America. That could not be done in a visit of five weeks. They desired, principally, to see those things that could be used in argument against legislation of which they disapprove, against methods of management which they regard as backward, and against trade union activities which they deem dangerous. Of course, they found what they wanted. They found American financiers marvelling at our high taxation, and managers wondering at our obsolete methods; they found trades unionists investing in shares and scorning ca-canny, and the whole population inspired by the latest slogan "Service to others." They found also that one person in every ten of the population had a motor car, which convinced them that the country is very rich, and

they found one workman attended three machines, which would have employed six men here, which convinced them that the people are very industrious. All these things they saw and told us about for our good. Had they gone out with quite opposite intentions; had their object been to prove that Great Britain was a much better place to live in than America; that there is less poverty, more far-seeing social legislation, a truer democracy, deeper sympathy between capital and labour, and more real service to others in this country, where we do not talk about such things, than in the United States, they could have seen all those things too. When you make a five weeks' visit to a foreign country, and particularly when you make it with a definite purpose in view, more is not to be expected than a sketch of one facet out of a thousand. Mr. Benn and Mr. Elliott know that they have not told us the whole story. They know that the United States, like our own and every other country, is compounded of good and ill, and they guess, no doubt, that even the good things they saw, and on which, quite rightly, they laid stress, have a seamy side that was not shown to them. All that does not matter very much if they can achieve their object, if they can bring it home to the people of this country that our economic system is being strained to the breaking point, and that to keep our foreign trade we must change some of our methods.

We do not like, we do not trust, comparisons between our little kingdom and others. We never have liked them. Our dislike does not spring from a distaste for comparative criticism in which we are the victim. We could bear that if it were really good for us. We dislike comparisons for two reasons. In the first place, they tend to weaken our trust and belief in ourselves, and, in the second, they are invariably attempts to compare two incomparable things. In George Eliot's description of the character of the Rev. Amos Barton she says it was fortunate he could not see himself as others saw him. "That is a deep and wide saying that no miracle can be wrought without faith—without the worker's faith in himself, as well as the recipient's faith in him. And the greater part of the worker's faith in himself is made up of the faith that others believe in him." That shrewd observation will apply just as well to nations as it does to Mr. Amos Barton. The habit of calling ourselves bad names, of putting on the cloak of humility and going forth to see how others do things, and then organising a procession in white sheets and candles towards the banquetting table, where we confess our offences in after-dinner speeches, is not nearly as useful to us as those grossly utilitarian vices, an over-weening confidence in our own merits and an intolerable pride in our own capacities. More real good is done to Great Britain by every American who comes over here and goes back to his own country, as fortunately thousands do, with a satchel full of the merits of these islands than by ten thousand speeches by our own people on our manifold defects. The first step towards honour is to honour yourself. Then as regards the incomparability of this country and others. What kind of resemblance is there between new America and old England, between a cosmopolitan population in a vast area and a native population in a small one? There is all the difference of the eastern and western hemispheres between us, and all the waters in the Atlantic separate us. We are cousins by blood, but not cousins by environment. We cannot imitate their methods any more than they can imitate ours. And neither of us will gain aught by trying. There was a time, not so many years ago, when everything Germany did was held up as a lesson to us. Those days have gone, but they made their mark. We depreciated ourselves daily, and by how much we thereby precipitated the war it is too soon to say. Fortunately, Germany was as much deceived in us as we were deceived in ourselves. Let us hold to ourselves now. It does not follow that because Germany or America or Japan or China or France has a particular way of doing something, whether it be organising research or making collar studs, that it is better than our way. If we find our own way of solving our own problems, it is ten to one we shall be more easy on it than if we follow other people's ways. In any case, a course of peaceful jingoism will do us more good now than this white shirt and candle business. We need to ruffle it a bit, to swagger a bit. We need to assert quite boldly, and, for the present at least, if you like, in manifest disregard of all data, facts, and statistics, that all that is best in the world is British. Our old insularity may have been very provoking to others, but it was just as helpful to us then as their continentality is to them now. We do not mean, of course, that we are to be satisfied with ourselves just as we are. Far, indeed, from it. More effort on all sides, more intelligence on all sides, is called for. What we do say is that we should look to our own intelligence and not to that of other nations, and that we should direct all our increased efforts in our own national way.

We shall give quite a wrong impression of what Mr. Benn and Mr. Elliott said if we lead anyone to suppose that we are tilting at their speeches. As a matter of fact, they intentionally saw American industry through rose-coloured spectacles, and we listened with the greatest interest to their admirable exposition of the picture it presented. Our remarks on their observations may be regarded as no more than high-tension induced comments. It is against a general attitude of mind rather than against specific utterances that we speak. We are confident that every nation is happiest and best when it is exercising its own personality and not trying to graft plums on pear trees. Science and technology will do all and more levelling than we want. For the rest, the more we can retain of our own individuality, the more we can depend upon our own methods and the less on those of other nations, the better for us.

## The London Electricity Supply Problem.

No. VI.*

THE most important evidence given during the past week at the inquiry into the electricity supply of London was that of Mr. C. H. Merz and Mr. Sparkes, the promoter of the first scheme for co-ordinating electricity supply in the London area on behalf of the County of London Electric Supply Company. This company appears in the inquiry as an objector to the other schemes, and gave evidence at the request of Sir John Snell. It has been mentioned already that the County Company has a scheme before the Commissioners for the building of a 100,000-kilowatt power station at Barking, with an ultimate capacity of 600,000 kilowatts. It was contended by Mr. Merz and Mr. Sparkes that it would be a wise course to erect such a station at once in order adequately to meet the demands in the County Company's area, which includes a large district in which important industrial developments are anticipated. Even on the present demands it is estimated that a return of 11 per cent. would be shown on capital expenditure involved, which would run into some 3½ millions sterling. The station, of course, would be erected by private enterprise. On the other hand, Sir Alexander Kennedy, Mr. G. W. Partridge, Mr. C. H. Wordingham, and Mr. J. H. Rider, who constitute the Board of Engineers which has drawn up the technical scheme for the proposals which have been placed before the Commissioners by the L.C.C., the Conference of Local Authorities, and the nine companies, have laid it down that, owing to the present state of finance and the high price of plant, it is uneconomical and inadvisable to proceed with the erection of capital stations at once, but that the existing stations should be extended as far as possible and linked up, thus postponing the erection of capital stations for quite a long period, put at anything up to seven or ten years. Mr. Merz is diametrically opposed to this policy, or "no policy," as he put it, and favours the bolder policy of erecting a capital station at once. He would go ahead with a capital power station or stations in anticipation of the load, so as to be able to offer current to the railway companies and other large users. Personally, he said, he did not view with dismay the laying of 10, 15, or even 20 miles of trunk mains before consumers were obtained, for he had no doubt that he would enrol the consumers when he had laid the mains. Such a policy, he said, would hasten railway electrification all over the country. As to the high prices for plant rendering it inexpedient to erect new capital stations at once, Mr. Merz said that, taking into account the higher efficiency of plant now, prices were comparatively as low as, if not lower than, pre-war, and he instanced a 15,000-kilowatt turbine which he had ordered within the last three months at £3 per kilowatt for the turbine, without condenser. On the other hand, a figure mentioned by the companies as being the price quoted in a recent tender was £7.84 per kilowatt for a 10,000-kilowatt turbine, again without condenser.

Another argument put forward by Mr. Merz in favour of installing large modern plant at once is the thermal efficiency. The average thermal units required per unit of electricity sent out in the London stations to-day is 43,000, and the average estimated when the first stage of the proposals of the L.C.C. and the others is completed is put at 31,350. Against that, a figure of 17,000 thermal units per unit of electricity sent out is being worked to in the Dunston power station of the Newcastle Electric Supply Company and also in Chicago, and Mr. Merz urged that the whole foundation of cheap current is low fuel cost. In this connection radical changes were foreseen, and, visualising the power stations of the future—it was stated that coal distillaton plants would be installed in which at least part of the coal required for the generation of electricity would be carbonised and a section of the generating plant set aside for oil burning with the oil so obtained.

Mr. Merz impressed very strongly upon the Commissioners the fact that our export trade in electrical machinery is suffering badly because we are not going forward with power supply developments in this country quickly enough. The result is that our manufacturers lack the experience with large modern plant so much needed, especially in the Colonies, and as a consequence large orders are being placed elsewhere. Only quite recently the Melbourne Corporation placed a large order in America because British manufacturers had not had the opportunity of gaining experience with such plant at home. It was only on the North-East Coast that any attempt was being made in that direction. There were four large manufacturers of electrical plant here, said the witness, who were quite capable of manufacturing any machinery, and it needed the putting into operation of as many large power schemes as possible to give them the chance of developing on the right lines both in the interests of the country itself and also to enable us to hold our own in foreign countries.

So far as the proposal of the County of London Company to erect a power station at Barking is concerned, that, of course, is not actually before the Commissioners now and does not form part of the present inquiry. At the same time, it is claimed on the company's behalf that for the needs of its two small districts in London and the larger undeveloped industrial area in Romford, the new power station, beginning with 60,000 kilowatts of demand, is urgently necessary, and to strengthen the case for the company in particular and to emphasise the backwardness of London in general, Mr. Merz made the comparison so often adopted of the units per head of population used in various places. As showing how undeveloped the County of London Company really is, having regard to the industrial character of the whole of its area, it was pointed out that the consumption per head of population is only 50 units; in Greater London it is 96; in Glasgow, 189; on the North-East Coast, 293; the Mersey Power Company shows a figure of 369; whilst Chicago was 550. The reason for the high latter figure was that the whole of the supply, including transportation, was given from the same stations. Mr. Sparkes' evidence was on the more domestic side of the development of the County Company's business.

* No. V. appeared July 15th.

## Literature.

*The Air Supply to Boiler-rooms of Modern Ships of War.* By RICHARD W. ALLEN, C.B.E. London: Charles Griffin and Co. 1921. New edition. 42s. net.

THE science of stream lines is a modern science. It goes back, if any, little further than the days when Dr. Hele-Shaw, fresh from South Africa, set Europe talking with his elegant optical demonstrations. It was not that we did not know anything about the flow of liquids before that time; but we had not grasped fully how much it meant, and we did not understand, because we could never see, the waste of energy that resulted from defective stream forms. Not many years later the flying machine became an established fact, and the attention that we had given to relatively dense fluids, like water, had to be turned to air, a fluid which, owing to its high compressibility and low viscosity, presented new and more complicated problems. Not only did we have to give close study to the form of aerofoils and balloons, but the minor details, and particularly struts and wires, had to be carefully proportioned to present the least head resistance. Thus, we were soon deep in a careful research into the flow of air past obstacles.

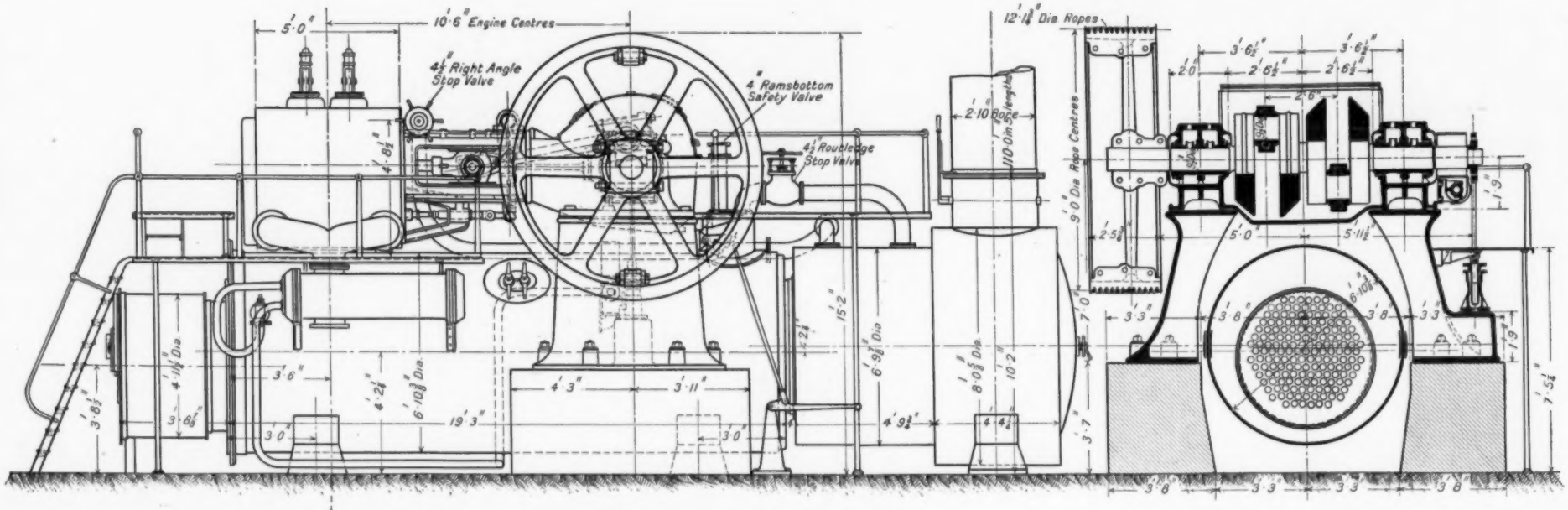
If it had not been for these beginnings, it is probable Mr. Richard Allen would never have made the experiments on the flow of air to boiler-rooms, and never have written a book which has directed thought into a new channel. Until he began his research, no one troubled much about how air got into the ducts in a ship or what it did when it was once in. It was deemed sufficient to give sufficient area to keep the velocity below a certain maximum. What it did, into what convolutions and twists it was tortured in passing through gratings, round bends and past impossible corners, no one considered. If the fan were kept supplied, that was all that mattered, and goodness knows how much efficiency was thrown away by the neglect of those things which Mr. Allen has now shown us are of importance.

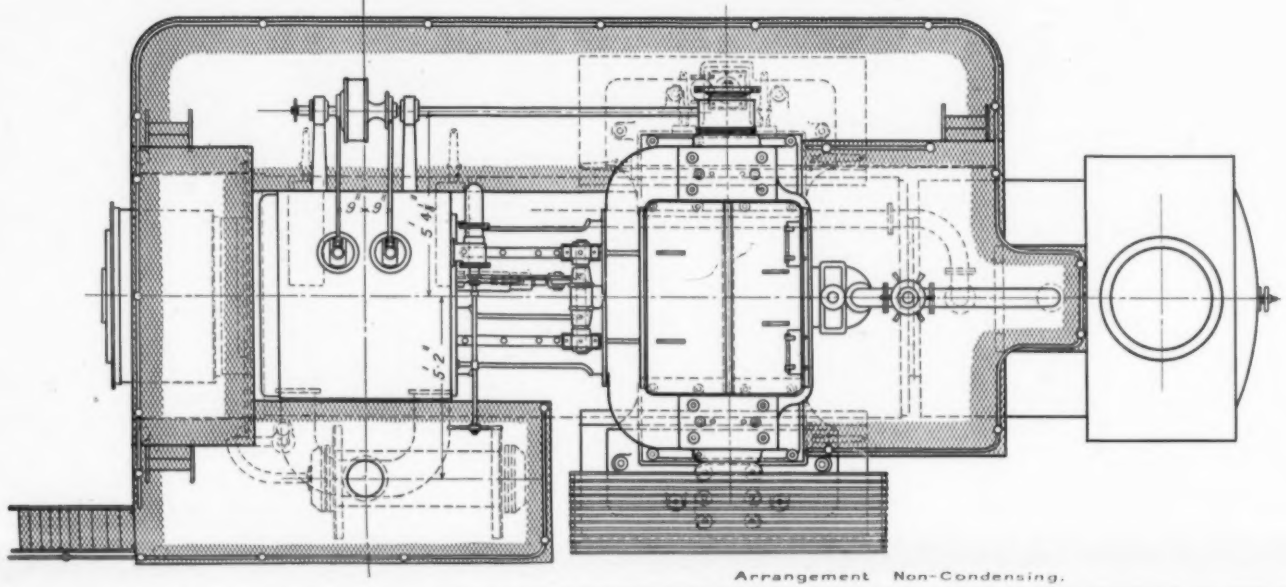
His book appeared first in June, 1916, when we were in the middle of the war, and though it directed attention, as we have said, to a neglected subject, it did so under a certain measure of restraint, as it was deemed advisable to give as little information to our enemy as the case permitted. "Press censorship" has gone, and in the new edition Mr. Allen is able to go more deeply into his subject, so that to all intents and purposes this new edition is a new book. It arrives, so to speak, at the psychological moment, for during the past few weeks more attention has been given to oil fuel than in twenty preceding years, and it is to the oil-burning steamship that the author turns especial attention. Higher air pressures are required in oil-burning than in coal-burning ships, and the power consumed by the fans is so great that even a small percentage economy is worth while.

Mr. Allen has attacked the whole question of air supply in a very thorough manner, and has verified

# 500 HORSE-POWER COMBINED ENGINE AND BOILER

ROBEY AND CO. LIMITED, LINCOLN, ENGINEERS

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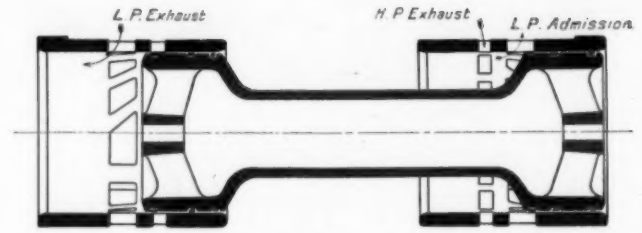


Intermediate Piston Valve.

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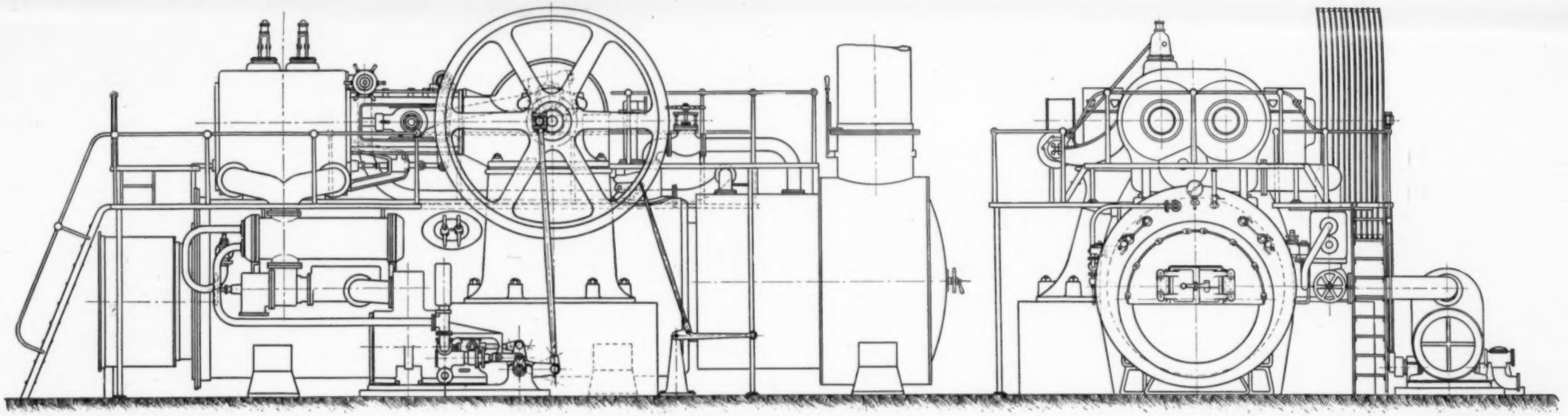

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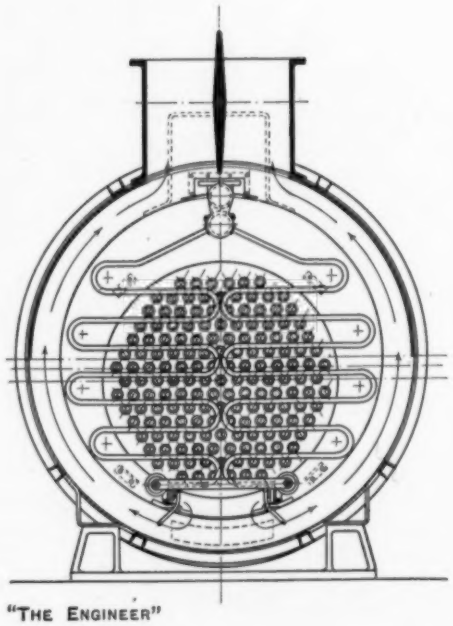

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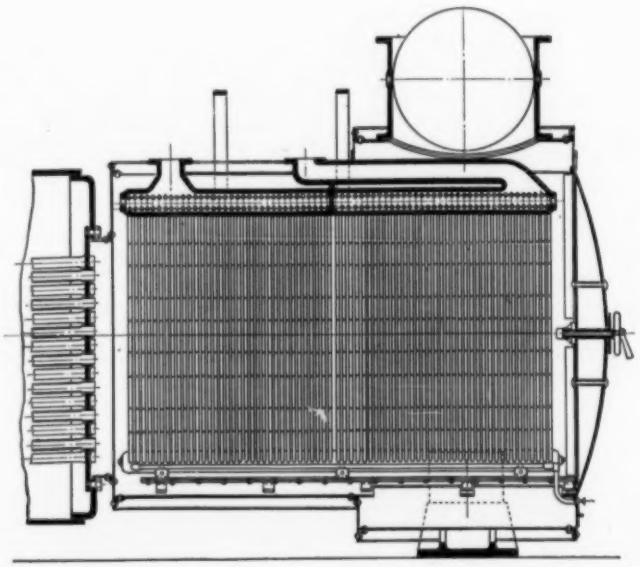
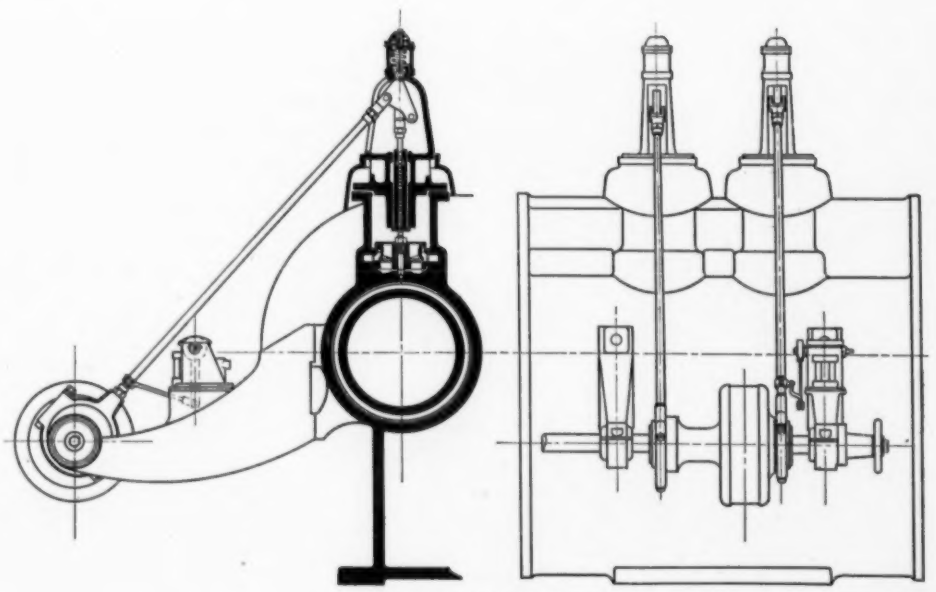


Superheater



H.P. Cylinder Valve Gear.

SWAIN Sc.

his calculations and theories by actual tests, either at the works of his company or on board ship; but the outstanding feature of his investigation is the practical application of stream-line theories. Here he admits there is a great deal still to be done. "When passing in review the difficulty of guiding air into the entrances and through the intakes," he writes in his preface, "with the least possible resistance, as well as the question of the distribution of air in the stokeholds, one is forced to the conclusion that only the fringe of this important subject has been touched, especially having regard to the growth of the naval units during the last four years, and the great increase in the power of their propelling machinery, calling for much larger quantities of air to be delivered by the fans." We cannot say whether Mr. Allen has, in fact, only touched the fringe of the subject, but it is at least certain that he has initiated an entire change in the attitude of mind towards air supply, and that the bad old days when anything was good enough, and no one hesitated to stick angular obstruction in the middle of air trunks, have gone for ever. He has shown the necessity for clear runs and ample cross-sectional area, and has pointed out the economy that results from following stream-line laws, and we may rest assured that in all ships for the future these things will be thought of, and in all the best ships air supply problems will be treated scientifically.

We recall that in reviewing this book when it first appeared, we advised shipbuilders to beg, borrow or steal copies of it. That was during the war. Then copies might have been hard to obtain; now one need only go to the bookseller and order them. He may be safely recommended to do so, not only for the sake of the information in the book, but because it stimulates thought. We never read a book of this kind without experiencing an uneasy feeling that we are surrounded by all sorts of things that want reforming, and could be reformed—just as the air supply to boiler-rooms is being reformed—if someone would perform the office that Mr. Richard Allen has performed and point them out to us.

## Registration.

THE following article is reprinted from our honoured contemporary, the *Architect*, by permission of the Editor. The arguments advanced in it are just as applicable to engineering as they are to architecture, and for that reason will be studied with interest by our readers.

The letter which we publish over the signatures of two vice-presidents of the Institute, and others, is one with the substance of which we do not agree, for it seems to us that unification, without which registration is impossible, must precede, and not follow, registration. Unification is practicable, desirable, and eminently reasonable, for nothing has been more undignified and harmful than the effect produced by the existence of the Institute and Society, both representing architects, but each, apparently, struggling for precedence and each issuing appeals to architects on the same issues and for the same object. "L'union fait la force;" and if there is any driving force behind the profession it can only be fully exercised if architects are united among themselves. It has been urged that the Unification Committee, in seeking its end, is opening the doors of the Institute too widely, and that in the rush which is expected to follow many may obtain a status to which their education and attainments do not qualify them. This may, or may not, be the case; but, even if it is, we should ultimately in time eliminate such defects which are very possibly inseparable from any scheme of unification, for the attainment of which it may be desirable to make very considerable sacrifices.

Probably most architects have at some period or other been more or less keen advocates of registration, and undoubtedly at the present time an overwhelming majority would be found to be in favour of the promotion of a measure of registration. The prevailing belief at the present time is undoubtedly that most of the evils under which mankind suffers can be cured by legislation; but, although evils are undoubtedly caused by unwise legislation, the extent to which mankind is benefited by any legislation is enormously exaggerated in the popular mind, and this applies to the section of public which forms the architectural profession. National wealth cannot be built up by legislation, but is the outcome of the natural resources of any country and the manner in which they are exploited by the individual effort of individuals and associations of individuals, and similarly the well-being of architects as a whole depends on the need that is felt for their services by the general community and the extent to which they, as individuals, can convince other individuals, of which the public is composed, of the advantage they may secure by employing them. We cannot—unless we assume that we are powerful enough to dictate to the State—force the individuals who compose it to employ us if they do not think it advisable in their own interests to do so, nor can we force anyone to pay us certain fees if they consider they can obtain equal advantages by paying others smaller sums. We may possibly restrict the use of the title "architect" to those who belong to the Institute, but when we have done so we have done little unless we have at the same time convinced the public that only an architect can give them what they want. At the present time a large section of people believe they can get all they require by going to an estate agent or to a builder, and if they are so convinced we cannot alter facts by emphasising names. We have to remember that the Merchandise Marks Act was passed in the hope that it would prevent people from buying cheap foreign goods, but in operation it served to advertise those goods. It is thus conceivable that registration would simply serve to deflect work away from architects, and not to bring it to them.

We do not take this view, but believe that the panacea of any measure of registration which could be passed would prove to have effected little or nothing, and we should be thrown back to the basic fact that a man's success in life depends on his personal and individual ability to prove to those with whom he comes into contact that his services are worth having and paying for.

It is possible that certain measures may prove a means which will enable him to secure legal redress in difficult cases, but it is also certain that a successful man rarely places himself in such positions that he has to evoke the assistance of the law. Success depends in the main on the individual's ability by wisdom, skill, and insight into the minds of others in avoiding controversies; and many men have fought and won law suits to find themselves almost as much damaged by success as they would have been by failure. Many of us might, in a word, do better if we carefully considered not only what we were obtaining from our clients, but also what tangible advantages our clients obtained through our aid, for it is on the principle of the *quantum meruit* as determined by public estimation that each man's success in life is determined. If we satisfy those who consult us, our own success will be certain—if we do not registration will not help us.

Although architecture is a practical occupation it is also an art, and there are immense difficulties in applying tests which can prove that individual applicants in an examination possess the requisite powers of designing ability. If they have, they may not have what is almost as necessary—the power of carrying out their clients' work efficiently. We are not arguing against the application of the tests used by the R.I.B.A., but merely suggesting that, in the case of the public, such tests are hardly sufficient to dispose everyone to believe that their objects can only be obtained by the means of the registered architect. It is for the individual practitioner to prove in every case to his clients that he is competent; and, if practising architects are able to do so, there will be little inclination to go outside their ranks, which is, in the end, what we all want to bring about.

## Lloyd's Register of Shipping—1921-22 Edition.

THE new edition of Lloyd's Register Book contains, as usual, particulars of all the sea-going vessels of the world of 100 tons and upwards. It includes records of upwards of 33,000 steamers and sailing vessels, and, in addition, much information of practical value to the shipping community, such as lists of shipbuilders and marine engineers in all countries; telegraphic and postal addresses of firms connected with shipping in all parts of the world; particulars of dry and wet docks, ports, harbours, &c., at home and abroad, of speeds of merchant steamers capable of 12 knots, and of deadweight and cubic capacities of cargo steamers and motor vessels; lists of bulk oil carriers, and of shipowners and managers, with the names and tonnages of their respective vessels, &c.

The section of the book which is perhaps of the most particular interest to the general public is that containing the statistical tables. From Table No. 3 we learn that more than 28½ million tons of shipping are classed by Lloyd's Register. Table No. 1 shows how the several countries are recovering from the war period, and that there are recorded in the Register Book—excluding vessels of less than 100 tons—4773 sailing vessels of 3,128,328 tons and 28,433 steamers of 58,846,325 tons, thus making a world's total of 33,206 vessels of 61,974,653 tons gross. It is made evident in the tables that the reduction in sailing tonnage since pre-war time—say, June, 1914—amounts to 852,000 tons, which is a much smaller decrease than any that occurred in the previous period of seven years. The lessening in the falling off is, it is explained, principally due to the increase which has taken place in the United States, the only country which has added to its sailing tonnage since 1914, apart from any ex-German tonnage allocated. Nearly 41 per cent. of the world's sailing tonnage is now owned in the United States. It should, however, be remembered that the figures for that country include a large proportion of sailing barges. The other countries which still have a considerable amount of sailing tonnage are the British Empire, 482,000 tons; France, 353,000 tons; Norway, 213,000 tons; and Italy, 183,000 tons. The percentage of sailing vessels to the world's tonnage is now 5 per cent. as compared with 8 per cent. in 1914, and nearly 22 per cent. in 1902.

The tonnage of wood vessels owned in 1914 amounted to 1 per cent. of the total steam tonnage, whereas that percentage has now risen to 3.9 per cent. The rise is, of course, one of the effects of the shortage of tonnage during the war, which resulted in the construction of a large number of wood vessels. Whereas in 1914 the wood sea-going tonnage owned in the United States amounted to 210,000 tons, the corresponding figure is now no less than 1,210,000 tons. Some interesting particulars are given concerning the sea-going steel and iron steam tonnage owned by the principal maritime countries of the world. We reproduce them in the following table:—

| Country. | June, 1914. | June, 1921. | Difference between 1921 and 1914. |
|---|---|---|---|
| | Tons gross. | Tons gross. | Tons gross. |
| United Kingdom .. | 18,877,000 | 19,288,000 | + 411,000 |
| British Dominions .. | 1,407,000 | 1,950,000 | + 543,000 |
| America (United States) | 1,837,000 | 12,314,000 | + 10,477,000 |
| Austria-Hungary .. | 1,052,000 | Nil | — |
| Denmark .. .. .. | 768,000 | 866,000 | + 98,000 |
| France .. .. .. .. | 1,918,000 | 3,046,000 | + 1,128,000 |
| Germany .. .. .. | 5,098,000 | 654,000 | - 4,444,000 |
| Greece .. .. .. .. | 820,000 | 576,000 | - 244,000 |
| Holland .. .. .. | 1,471,000 | 2,207,000 | + 736,000 |
| Italy .. .. .. .. | 1,428,000 | 2,378,000 | + 950,000 |
| Japan .. .. .. .. | 1,642,000 | 3,063,000 | + 1,421,000 |
| Norway .. .. .. .. | 1,923,000 | 2,285,000 | + 362,000 |
| Spain .. .. .. .. | 883,000 | 1,094,000 | + 211,000 |
| Sweden .. .. .. | 992,000 | 1,037,000 | + 45,000 |
| Total abroad .. | 23,637,000 | 34,929,000 | +11,292,000 |
| World's total .. | 42,514,000 | 54,217,000 | + 11,703,000 |

It will be seen that amongst the principal countries, apart from Germany, and, of course, Austria-Hungary, Greece is the only one which still shows a reduction in the tonnage now owned as compared with 1914. Notwithstanding the increased construction and the large amount of ex-enemy tonnage allocated to British ownership, which are included in the figures given, there are at the present time only 411,000 tons more owned in the United Kingdom than in 1914. The sea-going tonnage of the United States, on the other hand, has increased by nearly 10½ million tons, an increase of 570 per cent. on the 1914 figures. The other countries in which the largest increases are recorded are:—Japan, 1,421,000 tons; France, 1,128,000 tons; Italy, 950,000 tons; and Holland, 736,000 tons. As in the case of the United Kingdom, the figures for France and Italy include a considerable amount of ex-enemy tonnage allocated to these countries. The figures for Germany conclusively show the change in the maritime position of that country. While in 1914 Germany ranked next to the United Kingdom with over 5,000,000 tons of sea-going steel and iron steamers, her total tonnage now stands at only 654,000 tons. The United States percentage of the world's sea-going steel and iron steam tonnage has increased from 4.3 in 1914 to 22.7 in 1921. The relative position of some other countries has also altered to a large extent. In 1914 the United Kingdom owned nearly 44½ per cent. of the world's sea-going steam tonnage, the present percentage is just over 35½. Norway, which occupied the third place, is now sixth, while Japan, which was sixth, is now third, closely followed by France with only 17,000 tons less. Taken together, the Scandinavian countries—Norway, Sweden, and Denmark—show an increase as compared with 1914 of 505,000 tons. The net world's increase is 11,703,000 tons.

In 1914 there were 3668 sea-going steamers, each of 4000 tons and above; there are now 5209. The greatest increase has taken place in those of between 6000 and 10,000 tons, their number having increased from 1004 in 1914 to 1784 in 1921. Then, again, whereas in 1914 there were in existence 385 steamers for the carriage of petroleum in bulk with a total tonnage of 1,479,000 tons, the present book includes 861 steam and motor vessels of 4,419,000 tons for that trade, an increase of 200 per cent. in the tonnage. If the smaller vessels were excluded—say, those of under 2000 tons, which are mostly used for local trade—the average of the other 731 would reach 5875 tons each. Included in the total are 55 vessels of between 8000 and 10,000 tons and 37 of over 10,000 tons each. The number of vessels fitted with internal combustion engines has greatly increased since 1914. At that date 290 such vessels of 234,000 tons were recorded in the Register Book, and now the total figures are 1447 of 1,263,000 tons. A great development has also taken place as regards the use of liquid fuel on board steamers. In 1914 there were 364 steamers of 1,310,000 tons fitted for burning oil fuel, whereas the present Register Book includes no less than 2536 such vessels of 12,797,000 tons, which tonnage is more than nine times larger than that of 1914. Only 72 per cent. of the tonnage of the merchant marine now requires coal, while in 1914 the percentage was 89. Another point of interest indicating the change which is taking place in the method of marine propulsion is the fact that the new Register Book includes some 1100 vessels fitted with both sails and auxiliary engine power; of this total 740 have motors and are, of course, included in the total mentioned above of 1447 vessels fitted with internal combustion engines.

## INSTITUTE OF METALS.

THE following papers will, it is expected, be submitted at the annual autumn meeting of the Institute of Metals, which is to be held in Birmingham on September 21st to 23rd:—

(1) Professor A. A. Read (Cardiff) and R. H. Greaves (Woolwich), on "The Properties of Some Nickel-aluminium-copper Alloys"; (2) R. T. Rolfe (Bedford), on "The Effect of Increasing Proportions of Lead upon the Properties of Admiralty Gunmetal"; (3) R. Genders (Woolwich), "Note on the Casting of Brass Ingots"; (4) T. G. Bamford (Birmingham), on "The Density of the Zinc-copper Alloys"; (5) Dr. P. Johnson (Birmingham), on "Experiments in the Working and Annealing of Copper"; (6) W. E. Alkins (Manchester) and W. Cartwright (Buxton) on "The Effects of Progressive Cold-drawing upon some of the Physical Properties of Low-tin Bronze"; (7) R. Genders (Woolwich), on "The Extrusion Defect"; (8) F. S. Tritton (Teddington), on "The Use of the Sclerescope on Light Specimens of Metals"; (9) D. H. Ingall (Birmingham), on "The Annealing of Rolled Zinc"; (10) Dr. D. Hanson (Teddington) and Miss M. L. V. Gayler (Teddington), on "The Constitution and Age-hardening of the Alloys of Aluminium with Magnesium and Silicon"; (11) F. Adcock (Sheffield), on "Electrolytic Etching of Metals"; (12) S. Beckinsale (London), "Note on Electron, the High Magnesium Alloy."

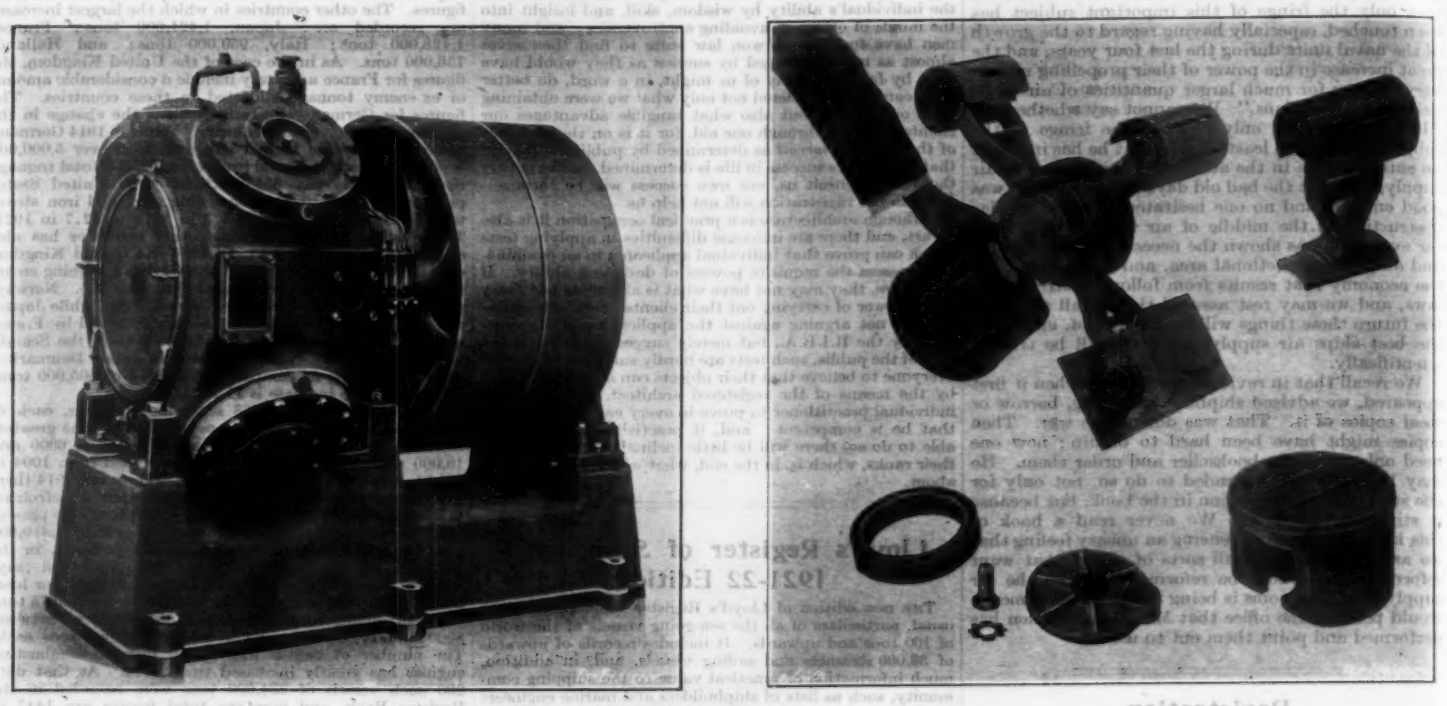
The papers will be presented and discussed at the morning sessions, the afternoons being devoted to visits to works and the evenings to social events, including a reception by the Lord Mayor and a garden party, whilst to conclude the meeting there will be a motor trip to Kenilworth, Warwick and Stratford-on-Avon.

A ballot for the election of members is now being arranged for the convenience of those persons who desire to participate in the Birmingham meeting. Full particulars can be obtained from the secretary, Mr. G. Shaw Scott, M.Sc., 36, Victoria-street, London, S.W. 1. Since the holding of the inaugural autumn meeting of the Institute in Birmingham in 1908, the membership has grown from 200 to over 1300. The coming meeting, marking as it does the first visit of the Institute to its old home, will afford a striking indication of the strides that have been made by the Institute since its timely foundation thirteen years ago.

THE Minister of Railways and Harbours of the Union of South Africa is considering the extension of the equipment at Table Bay docks. It has been decided to improve the coaling appliances and to install a 100-ton crane.

## The Reavell Quadruplex Air Compressor and Some Tests Thereon.

THE well-known design of quadruplex air compressor manufactured by Reavell and Co., Limited, of Ipswich, has recently been modified in several of its details, and in its new form has been subjected to a very thorough test by Captain H. Riall Sankey, C.B., R.E. (Ret.), President of the Institution of Mechanical Engineers. Captain Sankey's report, reprinted in full below, will, we think, be read with great interest by many engineers, for it introduces an important development in the method of testing air compressors.

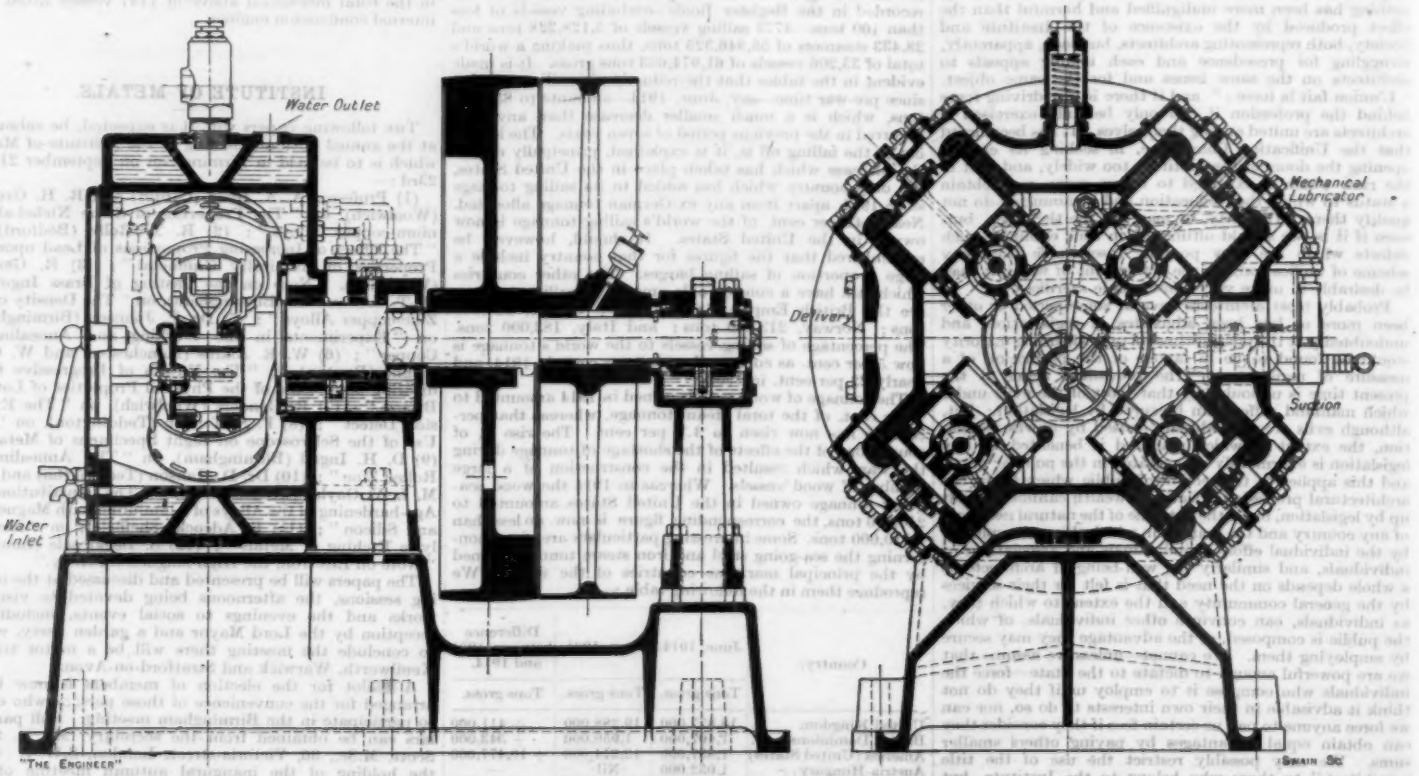


REAVELL AIR COMPRESSOR AND SOME OF ITS PARTS

Before inviting the reader's attention to the report we may perhaps with advantage briefly describe the compressor and its modified details as inspected by us during a visit to Messrs. Reavell's works shortly after Captain Sankey's tests had been made.

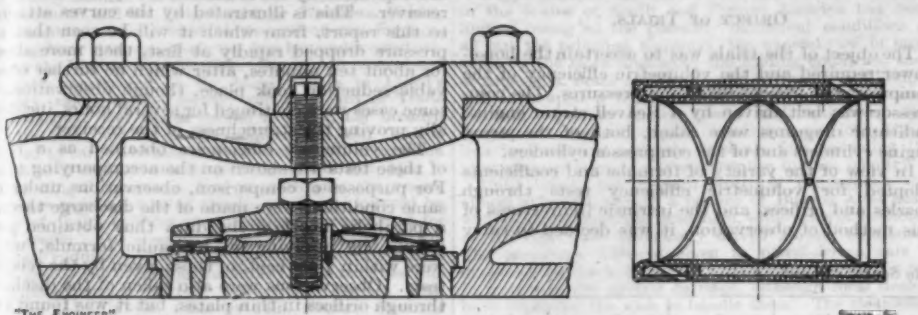
The compressor is made in various sizes, but in all the general design is the same, namely, the arrangement of four cylinders in one vertical plane and the driving of the four pistons from one crank pin at the end of an overhung crank shaft. The cylinder barrels project inside the crank casing and are there formed with ports through which, when the pistons overshoot them, air is admitted at atmospheric pressure into the cylinder interior ready for compression on the return stroke. Delivery is effected through a single valve of the disc type, situated centrally in each cylinder head, the air under pressure being passed through these valves into a more or less annular chamber which surrounds the crank case and from which a common orifice leads the air to the receiver or point of consumption. The use of a plate valve is one of the modifications introduced in the new design. In the earlier pattern the cylinder head was studded with a series of thimble valves, the number, but not the size, of which varied with the size of the compressor. The new arrangement substitutes a single spring disc for a series of spiral springs, permits the adoption of water cooling for the cylinder heads, and simplifies the erection and opening out of the cylinders and valves. But we are not convinced that it improves the efficiency nor, or so we believe, do Messrs. Reavell claim that it does. The trouble is, of course, that, however flat the valve disc may be originally when put in, it may in time become buckled and, as a consequence, cease to be as air-tight as is desirable.

In common with the earlier pattern, the new design is distinguished by the valve-like arrangement of the gudgeon pins and their housings in the piston bodies. The object sought is to make sure that from the very beginning of the outward or suction stroke the cylinders shall be in communication with atmospheric pressure. Without these gudgeon pin ports or something else taking their place a vacuum would, of course, form behind the piston on its outward stroke until the piston over-ran the inlet ports near the end of the cylinder barrel. In the engraving showing the general arrangement of the compressor the lower left-hand piston is just about to complete its delivery stroke. The gudgeon ports are, it will be seen, closed. The lower right-hand piston has just begun its suction stroke. The ports in this position of the piston are open and are admitting air at atmospheric pressure to the space behind the piston. The ports remain open throughout the suction stroke until the piston is about to over-run the ports at the outer end of the barrel as shown in the engraving in the case of the top right-hand cylinder. By the time the piston begins its compression stroke the gudgeon ports as represented in the top left-hand cylinder are closed, and they remain closed until after the air has been discharged through the delivery valve.



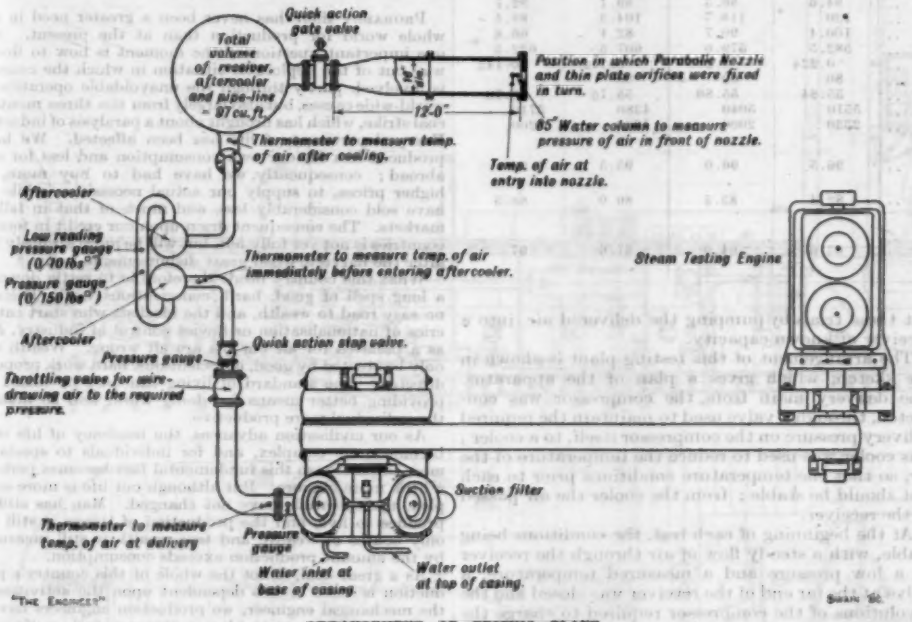

LONGITUDINAL AND CROSS SECTIONS OF QUADRUPLEX AIR COMPRESSOR

The design and assembly of the pistons, gudgeon pins and connecting-rods are simple and interesting and permit of the parts being stripped and re-assembled in a few minutes. The crank pin is surrounded by a bush—of which we give a separate illustration—composed of a steel centre covered on both sides with white metal. It should be remarked in passing that this bush—a new feature—is now used instead of a bronze one, although it is considerably more expensive to manufacture. Its value lies in the fact that should the white metal run, the connecting-rods will still have the steel centre bush between their ends and the crank pin. The knock developed will be sufficient to attract attention, but the slackness will not be great enough to cause damage to any of the moving parts.




DELIVERY VALVE AND CRANK-PIN BUSH

The connecting-rods are provided with tee feet, which are held to the bush by means of a pair of white-metal-lined rings as shown in the general drawing, one of these rings being slipped over the crank pin bush before and the other after the feet of the rods have been applied to the bush. The bush, connecting-rods, and rings are prevented from moving endwise off the crank pin by a circular cast plate attached to the crank pin by a set screw. The plate is formed with a pocket, into which an oil pipe projects through a hole coaxial with the centre line of the crank shaft. The set pin is drilled to establish communication between the pocket and a blind hole in the crank pin, whence the oil is conducted to the surrounding bush and the connecting-rod feet. The small end of the connecting-rod—a forging—is rigidly fixed to the gudgeon pin—a casting—by a pin and key. From the second half-tone engraving it will be seen that with the set pin, holding the plate and outer retaining ring, removed the connecting-rod and gudgeon pin can be disengaged from the crank pin and piston by a simple sideways movement. In an actual test carried out in our presence at Messrs. Reavell's works we found that all four pistons, connecting-rods, and gudgeon pins, together with the holding plate, the two retaining rings, and the bush could be dismantled and laid on the floor 1 min. 4 sec. after the crank case cover had been removed. Re-assembly occupied 5 min. 40 sec., but we have every reason to believe that even this time could be considerably reduced, for it relates to a compressor, the parts of which had not become easy by prolonged running and were, therefore, inclined to stick during the re-assembling process.


Quick action gate valve
Total volume of receiver, aftercooler and pipe-line = 97 cu. ft.
Position in which Parabolic Nozzle and thin plate orifices were fixed in turn.
12·0"
85" Water column to measure pressure of air in front of nozzle.
Thermometer to measure temp. of air after cooling.
Temp. of air at entry into nozzle.
Aftercooler
Low reading pressure gauge (0/10 lbs")
Thermometer to measure temp. of air immediately before entering aftercooler.
Steam Testing Engine
Pressure gauge (0/150 lbs")
Aftercooler
Quick action stop valve.
Pressure gauge
Throttling valve for wire-drawing air to the required pressure.
Suction filter
Thermometer to measure temp. of air at delivery
Pressure gauge
Water inlet at base of casing.
Water outlet at top of casing.
"THE ENGINEER"

ARRANGEMENT OF TESTING PLANT

[COPY.]

REPORT ON TESTS OF REAVELL QUADRUPLEX AIR COMPRESSOR (1920 DESIGN) MADE BY CAPTAIN H. RIALL SANKEY, C.B., R.E. (RET.), AND LIEUT.-COL. C. E. P. SANKEY, D.S.O., R.E. (RET.).

DESCRIPTION OF COMPRESSOR.

The compressor tested was a 12½in. by 8in., single-stage quadruplex, rated at 672 cubic feet of free air per minute displacement, and compressing to a delivery pressure of 120 lb. gauge pressure.

This quadruplex type of air compressor has several advantages :—

(1) The weight and the space occupied is small.

(2) The cylinder clearances are small.

(3) The air suction and the air delivery has a practically constant flow; consequently the considerable inertia losses due to starting and stopping the air flow at the suction end and in the air main at each stroke, as in a simplex or even a duplex compressor, are obviated. The gain is enhanced if for any reason a suction pipe is necessary. The maximum pressure to which the air has to be compressed in each cylinder is therefore less. This reduction in inertia losses is obviously due to having four cylinders delivering successively into a common belt in which the air is moving in one direction.

(4) Being single-acting, the cylinder walls are cooled during the suction stroke and their mean temperature is lower than in a double-acting machine.

(5) The cylinders consist of thin cast iron liners inserted in the casing, and consequently the heat transmission to the cooling water is very efficient.

(6) The admission being through ports in the gudgeon pin, and corresponding slots in the piston, the difference of pressure needed to open a suction valve is not required, and thus the cylinder is filled with air at atmospheric pressure at the end of the suction stroke. The volumetric efficiency is thus increased.

IMPROVEMENTS IN THE 1920 DESIGN.

In this 1920 design certain improvements have been introduced as follows :—

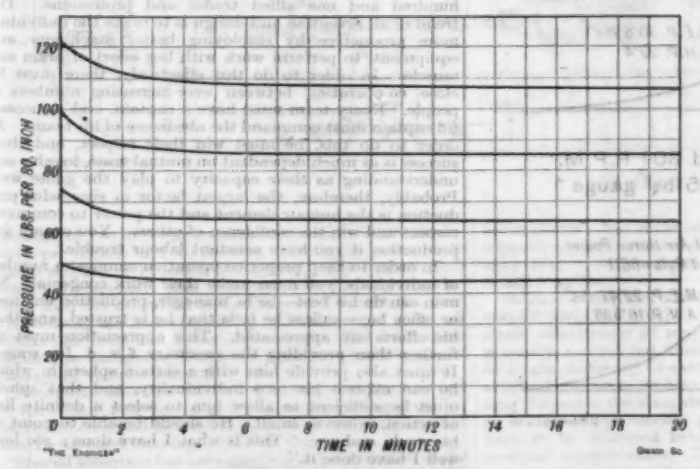
*Main Bearings.*—In this type of compressor the bearing between the crank pin and the big end of the connecting-rods has hitherto consisted of a sleeve made of phosphor-bronze. If lubrication is allowed to fail and overheating occurs it has been found that this metal is liable to crack. The improvement is to make this sleeve of steel on which what can be called a veneer of white metal is applied. The two retaining rings holding the big ends on to the crank pin also have a veneer of white metal. With this arrangement, in the event of failure of lubrication, the clearance produced by the running out of the white metal is insignificant, and, although not sufficient to lead to damage, causes a noise which gives warning to the attendant.

I am informed that a definite trial was made at the works by shutting off the lubrication and that an "unintentional" trial was made by a user; in both cases the arrangement was effective. It is only then necessary to fit the spare sleeve and retaining rings to enable the machine to begin to work again.

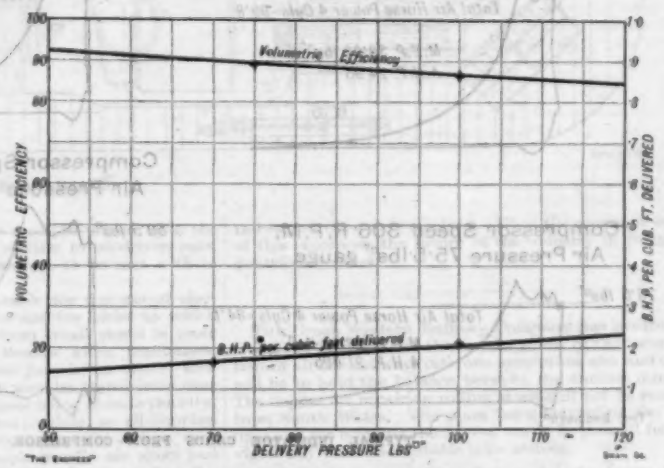
*Lubrication.*—A positive mechanical lubricator has been adopted instead of a sight-feed drip system. The bad results of neglect on the part of the attendant are thus obviated. The amount of lubrication does not depend on the temperature of the oil nor on the head of oil in the oil tank, and can be regulated with accuracy. The details of the new positive oil feed have been well worked out and, combined with the babbitted steel sleeve and retaining rings already referred to, make a satisfactory arrangement.

*Piston Rings.*—Air-packed piston rings, similar to those used in the Willans engine, have been adopted, because, as the result of lengthy trials, this form of ring was found to be much better for single-acting compressors than other rings, such as the Ramsbottom. During the suction stroke there is only a slight spring pressure between the rings and the cylinder walls, and during the compression stroke the pressure of the rings is proportional to the air pressure. Friction losses are thus reduced. My long experience of the Willans engine enables me fully to confirm the above.

*Connecting-rods.*—The old type of connecting-rod had a forged shank at the top end and passed into the centre of the gudgeon. Provision was made for a




PRESSURES IN THE RECEIVER




CURVES OF EFFICIENCY AND HORSE-POWER

"castle nut" to be attached to it and tightened by a spanner from a slot inside the gudgeon. It was thus accurately locked. In the 1920 type a forked connecting-rod, with a through pin securing it to the gudgeon, has been adopted. The greatly increased strength of this well-known system of construction has enabled the complication of air buffers to be dispensed with, resulting in improved cooling and greater simplicity.

*Cylinders.*—A manufacturing improvement of considerable importance has been adopted, resulting further in a convenience to users should a new cylinder be required, as will appear from the following:—

The old type cylinders were turned on the outside and were forced into the casing, and it was found impracticable to make such cylinders absolutely interchangeable. Hence if a renewal were required, the customer had to give the number stamped on the cylinder, so that the new cylinder could be machined accurately to obtain the desired forced fit. In the new type the forced fit has been dispensed with and the cylinders are bolted in place. The inner face of the cylinder is sealed against water pressure by means of a rubber ring (adopting gas engine practice) and the joint on the top face of the cylinder, which has to resist the air pressure, is made as a metal-to-metal joint. A new cylinder can therefore be dispatched at once from store in the event of a renewal being required.

*Valves.*—A new type of plate valve has been employed which brings this compressor into line with modern practice, and there is thus now only one valve required per cylinder, as there are no suction valves in accordance with previous practice in this machine. I understand, however, that no important advantages are claimed for this type of valve as compared with the previously adopted nested thimble valves, which have always operated most satisfactorily.

### Ease of Dismantling.

At the end of the preliminary trials on January 13th the compressor was dismantled; the cover plate securing the crank pin bearing was removed by unscrewing one bolt; the outer retaining ring was then taken off and the four pistons with their connecting-rods withdrawn one after the other; and, finally, the inner retaining ring and the crank pin sleeve removed, the whole operation taking under five minutes.

The bearing surfaces were quite cool and in perfect condition and showed not the least sign of grooving. I understand that previously to my test this machine had run for many hours including a *continuous* run of one week.

### Object of Trials.

The object of the trials was to ascertain the horse-power required and the volumetric efficiency of the compressor at various loads and pressures. The compressor was belt driven by a Reavell steam engine. Indicator diagrams were taken, both of the steam engine cylinders and of the compressor cylinders.

In view of the variety of formulæ and coefficients adopted for volumetric efficiency tests through nozzles and orifices, and the intrinsic indirectness of this method of observation, it was decided to carry out these trials by pumping the delivered air into a receiver of known capacity.

The arrangement of this testing plant is shown in the sketch, which gives a plan of the apparatus. The delivery main from the compressor was connected, through a valve used to maintain the required delivery pressure on the compressor itself, to a cooler; this cooler was used to reduce the temperature of the air, so that the temperature conditions prior to each test should be stable; from the cooler the air passed to the receiver.

At the beginning of each test, the conditions being stable, with a steady flow of air through the receiver at a low pressure and a measured temperature, a valve at the far end of the receiver was closed and the revolutions of the compressor required to charge the receiver from a lower limit of 10 lb. per square inch up to the delivery pressure of the test in progress were counted. This observation was checked by taking the speed of the compressor before and after each test and by timing the operation of charging the receiver. Five separate tests were made at each delivery pressure.

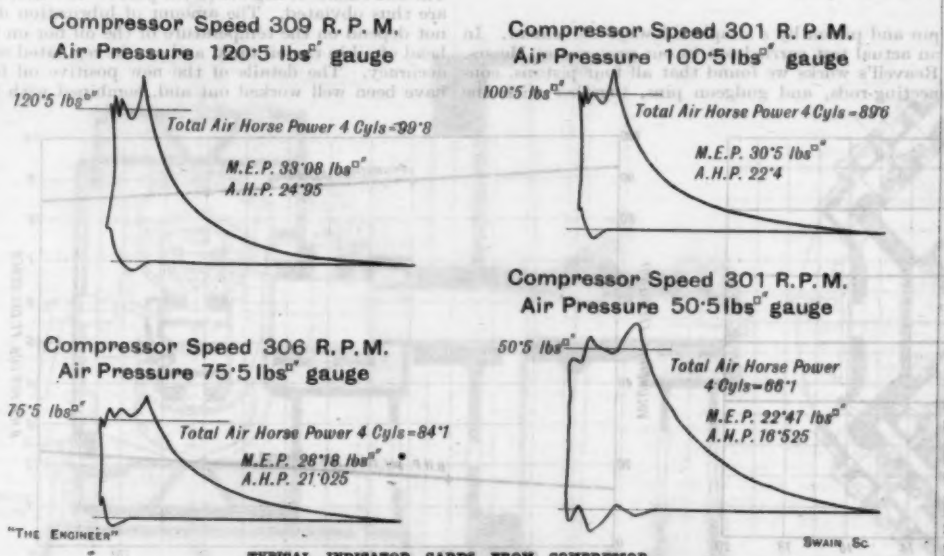
The temperature of the air in the pipe close to the receiver at the end of each charging was read, but the volumetric efficiencies worked out from these data were too high, and it was apparent that this temperature reading was not a true one. This is natural, as the air in the receiver is compressed by the air delivered by the compressor up to the final delivery pressure more or less adiabatically, depending on the speed of compression and the amount of surface of the receiver and pipe line.

To meet the difficulty the air was maintained in the receiver until the temperature conditions had again become stable, approximating to those of the suction air; this fall of temperature was necessarily accompanied by a reduction of pressure in the receiver. This is illustrated by the curves attached to this report, from which it will be seen that the pressure dropped rapidly at first, then more slowly for about ten minutes, after which no further observable reduction took place, though observations in some cases were continued for several hours, incidentally proving the staunchness of the receiver.

The volumetric efficiencies obtained as a result of these tests are shown on the accompanying table. For purposes of comparison, observations under the same conditions were made of the discharge through a parabolic nozzle; the data thus obtained gave results, by applying a hydraulic formula, which were within ½ per cent. of those given by the receiver tests. Observations were also taken of the discharge through orifices in thin plates, but it was found that they were not sufficiently reliable for comparison.

*Table Accompanying Captain Sankey's Report.*

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Pressure in delivery main, gauge pounds per square inch | 120 | 100 | 75 | 50 |
| Revolutions per minute | 309 | 301 | 306 | 303 |
| Receiver, cooler, and pipes charged from-to, pounds per square inch gauge | 10–122 | 10–99.5 | 10–74 | 10–50 |
| Revolutions taken to charge receiver, cooler, and pipes | 344 | 263 | 181 | 108 |
| Pressure in receiver, cooler, and pipes after cooling to suction temperature, pounds per square inch gauge | 107.5 | 86 | 64 | 43 |
| Volume delivered, cubic feet free air | 649.5 | 506.5 | 359.5 | 222.0 |
| Volume swept by pistons, cubic feet | 767.5 | 587.0 | 403.5 | 241.0 |
| Volumetric efficiency, per cent. | 84.6 | 86.3 | 89.1 | 92.1 |
| Horse-power at compressor shaft | 130 | 118.7 | 104.3 | 88.4 |
| Indicated air horse-power | 100.4 | 90.7 | 82.1 | 66.8 |
| Volume of free air actually delivered per minute at revolutions in line 2 | 582.5 | 579.0 | 607.5 | 622.5 |
| Brake horse-power per cubic foot delivered | 0.224 | 0.205 | 0.172 | 0.142 |
| Weight of cooling water per minute, pounds | 80 | 80 | 80 | 80 |
| Temperature range of cooling water, degrees Fah. | 55.84 | 55.80 | 55.75 | 55.70 |
| Horse-power at compressor shaft expressed as B.Th.U. per minute | 5510 | 5040 | 4380 | 3710 |
| Heat extracted by cooling water, B.Th.U. per minute | 2330 | 2000 | 1600 | 1200 |
| Thermal efficiencies— | | | | |
| $\frac{\text{Isothermal horse-power based on displacement}}{\text{Indicated air horse-power}} \times 100$, per cent. | 96.5 | 96.0 | 95.5 | 95 |
| $\frac{\text{Isothermal horse-power based on delivered air}}{\text{Indicated air horse-power}} \times 100$, per cent. | 82.4 | 83.5 | 86.0 | 88.5 |
| Overall efficiencies— | | | | |
| $\frac{\text{Isothermal horse-power based on delivered air}}{\text{Brake horse-power at compressor shaft}} \times 100$, per cent. | 63.6 | 64.0 | 67.6 | 67 |




TYPICAL INDICATOR CARDS FROM COMPRESSOR.

## Production and the Engineer.

By MAX R. LAWRENCE.*

Probably there has never been a greater need in the whole world for production than at the present. The one important question of the moment is how to find a way out of the deplorable situation in which the country is involved, partly through the unavoidable operation of world-wide causes, but also largely from the three months' coal strike, which has brought about a paralysis of industry. Every department of life has been affected. We have produced less for our own consumption and less for sale abroad; consequently, we have had to buy more, at higher prices, to supply our actual necessities, while we have sold considerably less, and much of that in falling markets. The consequent drain upon our credit in foreign countries is not yet fully felt, but will be more seriously felt after the harvest, when great disbursements begin.

What this country needs therefore is to settle down to a long spell of good, hard, conscientious work. There is no easy road to wealth, and the idealists who start catchcries of nationalisation or Soviet control of industry, &c., as a panacea for all our ills are all wrong. Wealth can only be created by good, conscientious, hard work properly directed. The standard of living can only be raised by providing better means for doing work, and so making the individual more productive.

As our civilisation advances, the tendency of life is to become more complex, and for individuals to specialise more intensely, so this fundamental fact becomes perhaps a little more obscure. But although our life is more complex, the essentials have not changed. Man has still to produce to live, and the production of things is still the only source of wealth, and true wealth is still measured by the amount production exceeds consumption.

As a great deal, if not the whole of this country's production is more or less dependent upon the activities of the mechanical engineer, we production engineers have a most important part to play in this country's welfare by developing to the utmost the economical manufacture of our engineering products. This Institution, therefore, would seem to be born at a very opportune moment, and I think we may consider to-day its true birthday.

Engineering production is essentially team work. The fitter cannot get on without the turner, and neither can do without the designer, moulder, the smith and the hundred and one allied trades and professions. The trend of all invention and design is to make the individual more productive by employing better machinery and equipment, to perform work with less effort of brain and muscle. In order to do this effectively, there must be close co-operation between ever-increasing numbers of people. Every team must have a captain, and a successful captain must command the obedience of his team. In order to do this, he must win their respect, and their success is as much dependent on mutual trust, loyalty and understanding as their capacity to play the game well. Probably, therefore, the largest factor in successful production is the human element and the power to command respect and win the confidence of others. You cannot get production if you have constant labour trouble.

In order to keep proper co-operation amongst a number of individuals, you must make their work congenial. No man can do his best—be he manager, production engineer or office boy—unless he feels that he is trusted, and that his efforts are appreciated. This appreciation must go further than providing the necessary £ s. d. for wages. It must also provide him with a certain sphere in which he can express his own individuality, and that sphere must be sufficient to allow him to select a definite line of action, however small. He should be able to point to his work, and say, "This is what I have done; see how well I have done it."

On page 466 of our issue of April 29th last was a description of the coaling plant at Sewell's Point, Virginia. In this connection it will be of interest to hear that on May 25th the Virginian Railway Company—whose railway was described in The Engineer of October 12th, 1917—made a test with a train composed of one hundred of its new 120-ton gondola cars, each loaded to its full capacity. The weight of the train was approximately 16,000 tons—of 2000 lb.—and it was handled by a 2–10–10–2 Mallet locomotive. The distance is 97.2 miles, and the testing point was a descent of 1.5 per cent.—1 in 66—for 12 miles. The speed varied from 20 to 27 miles per hour, and there was no difficulty in controlling the train by the Westinghouse brake.

* From an address at the first meeting of the Institution of Production Engineers, July 15th, 1921.

## The Ferry Steamer Liscard.

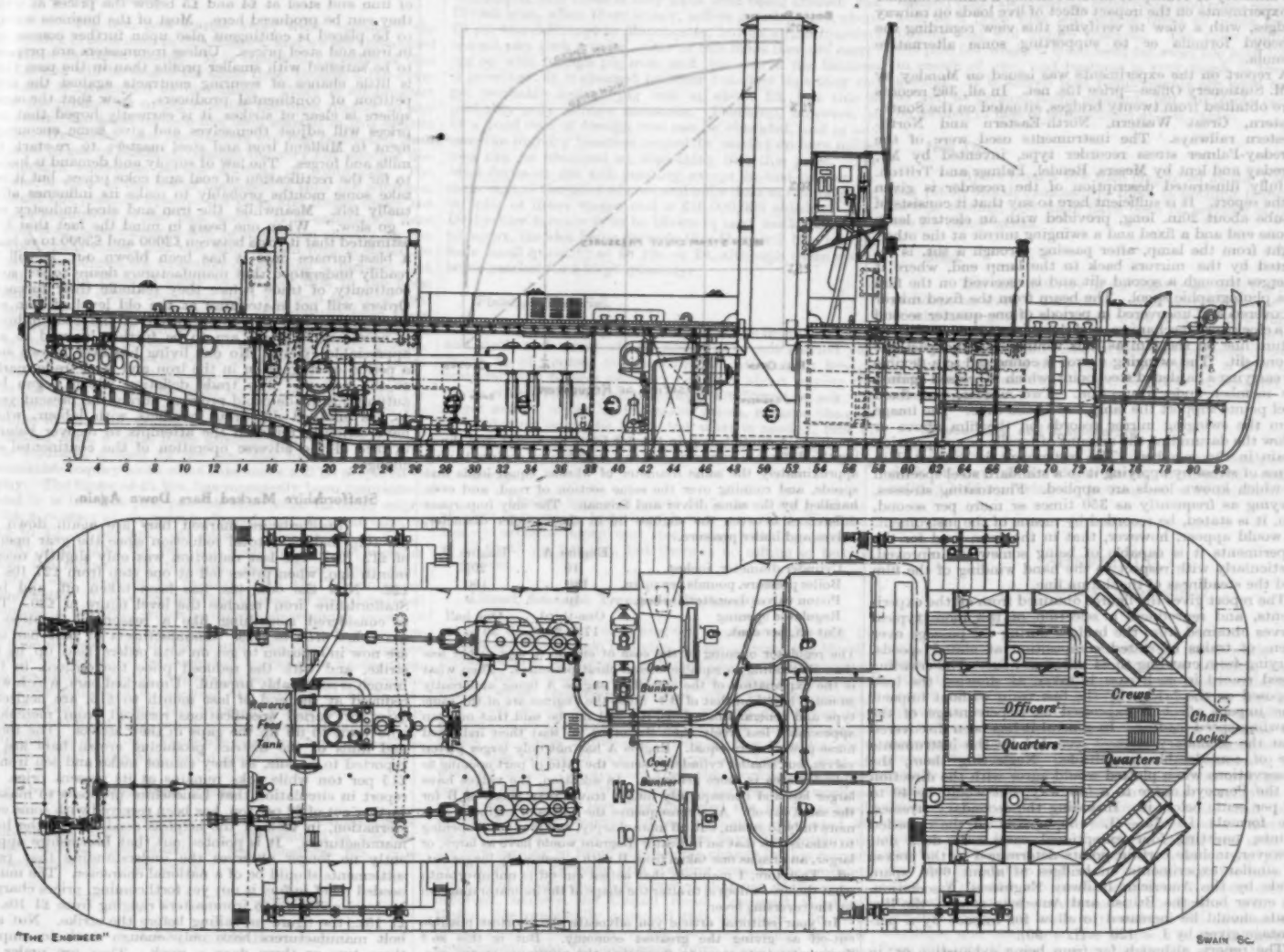
THE ferry steamer Liscard, which was launched by John I. Thornycroft and Co., Ltd., from their Woolston Works, Southampton, on June 22nd, is the first of two luggage-carrying ferry steamers which the firm has under construction for the Wallasey Corporation. She is built of steel and has been constructed to the highest class in Lloyd's Registry, under special survey, and to Board of Trade requirements. Her length overall is 150ft., her breadth moulded 50ft., and her depth moulded 15ft. 6in. She is designed to carry 170 tons of vehicular traffic, in addition to 45 tons of coal and stores, on a draught of 10ft. 4½in.

Four hinged gangways, two on each side the vessel, which are capable of being rapidly raised and lowered by means of double-cylinder steam engines, are provided for wheel traffic. The steering arrangements consist of twin balanced rudders operated by specially designed Hastie steam gear. The propelling machinery consists of two sets of triple-expansion surface condensing engines with cylinders 14½in., 23½in., 38in. by 24in. stroke. Steam is supplied by three cylindrical boilers of the return-tube type, 11ft. 6in. diameter by 10ft. 9in., with a working pressure of 180 lb. The engines are to run at 128 revolutions per minute and to develop 1200 horse-power, with which a speed of 11 knots is expected. The main deck is flush and practically clear from end to end of any obstruction, with the exception of the funnel. To meet the wear and tear of the heavy traffic it is being paved with oak blocks 5in. deep laid in tar and cement. The head room under the navigating bridge is such as to allow of the passage of vehicles beneath.

Accommodation for the crew is arranged at the fore end of the vessel, four cabins and a messroom being provided for the officers, and forward of them there is a compartment fitted with eight sleeping berths for the men.

Special attention has been given to the ventilation of the various compartments, powerful fans being fitted in the engine and boiler-rooms supplied from cowls and louvres in the wings of the vessel and exhausting up the funnel casing, which is made exceptionally large for this purpose. Similar arrangements are made for ventilating the crew spaces.

The interior of the hull is divided by means of water-tight bulkheads into a large number of water-tight compartments. The wings of the vessel are shut off by longitudinal bulkheads running the full length of the ship, and the wing spaces are further subdivided so that several adjacent compartments could be bilged without endangering the safety of the vessel.




THE FERRY STEAMER LISCARD.

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IT is officially stated that 254 standard gauge railway saloon coaches built for ambulance trains are still on the Government's hands, of which 101 are under negotiation for sale to the railway companies, and 43 have been retained by the Army authorities.

## Electric Vehicles in Latin-America.

WHILE hitherto the call for electrically driven vehicles in the States of South and Central America has been limited owing to the generally indifferent conditions of all but the principal highways, the expenditure of large sums by the Governments of the leading countries, such as Argentina, Brazil and Chile, upon new roads and bridges will soon open a new and important market for such vehicles, especially motor trucks and taxi-cabs. Oil-driven taxi-cabs have of late been introduced into Argentina in increasing numbers, and are fast becoming the most popular type of city conveyance in that country.

Until lately, the modern electrical conveyance was almost unknown, though a banker of Buenos Aires has a well-appointed electrical brougham, while some of the hotels of the city have electrically driven station omnibuses. The preference hitherto given to petrol-driven cars is explained by the fact that very little effort has been made to introduce the electric carriage, although local dealers have expressed the wish to handle them. The cleanliness and ease of driving which characterises the electric car would undoubtedly, it is thought, appeal to the user of automobiles; but little reliance must be placed upon the supposition that women prefer electric to oil-driven cars, since few, if any, women drivers are to be met with in South America.

General conditions are favourable for the use of electrically propelled trucks. There are few cities in which street distribution of supplies from retail stores is more generally carried out than in Buenos Aires, purchasers, as a rule, declining to carry their parcels, no matter how small. Provisions, such as meat, are also transported over long distances, the slaughter-houses being outside the city, as are all of the market gardens; while, as all supplies have to be delivered before noon, expedition is a very essential consideration. The hauls usually are short and there are frequent stoppages owing to the press of traffic. The gradients are very moderate, not only in the capital, but in other cities as well.

It has been decided to establish a number of charging stations in Buenos Aires, so that a system of public electrically operated automobiles may be commenced. As already indicated, taxi-cabs very soon became popular, a line of cabs having been started several months ago with encouraging results. Low rates for battery charging will be possible upon establishing a central station or stations, and this, it is thought, could be made the basis of a wide advertising propaganda in favour of the electrical vehicle, especially at a time like the present, when the cost of fuel of all kinds is a matter of extreme importance. The price of petrol, always high, has now reached 75 cents a gallon, while electricity for charging the batteries of a taxi-vehicle could be obtained, it is estimated, for 6 cents or less per kilowatt-hour.

The electric truck has also its future before it in Argentina, especially in the cities of Buenos Aires, Rosario, Mendoza, Bahia Blanca, and Cordoba. While the older portions of these cities, like all those of Spanish origin, are narrow, they are very straight, and the street widening programme now being carried out in most of the large towns of the Republic will soon remove difficulties caused by the narrowness of the thoroughfares. On the other hand, there are numerous fine avenues and streets, and as the cities are built in rectangular fashion, traffic conditions are favourable to motor trucks.

Brazil has latterly imported some electrically driven passenger cars, and it is proposed to extend the number if the experiment proves successful. The cities of Rio de Janeiro, São Paulo, Santos, and Bahia are well adapted to such vehicles, the street paving being excellent and the gradients very low, with but few exceptions. It is probable that with the present heavy cost of fuel, oil being both costly and difficult to obtain, a cheap and effective electric passenger car would prove popular at the moment. Owing to the large amount of water power available in Brazil, the price of electric current is moderate, while prospects of the development of the waterfalls under Government encouragement are exceptionally attractive. Motors, controllers, and batteries are being imported into the country in largely increased numbers, while recently six large electrically driven automobiles for carrying passengers in the capital between the port and the railway stations were received. Upon the economic success of this enterprise the future of the industry in Brazil will doubtless depend.

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THE Great Western Railway Company has assured the traders of South Wales that in the event of the incorporation of all the railways into one system its aim and object will be to hold the balance between the various interests. The depôts for repairing rolling stock will not be removed from South Wales. The plans for quadrupling the main lines and for bridging the Severn are to be pressed forward vigorously when the suitable time arrives.

IN the daily papers last week a statement was made that a high official in the railway world, seen after Sir Eric Geddes had said—as related in this column on July 15th—that there was a prospect of reduced fares, had expressed the opinion that after de-control passenger fares might be reduced by 25 per cent., and that that reduction might be followed by a further 10 per cent. in October. This official was reported as also saying that "before any such action can be considered there will have to be many economies, as by cutting off unremunerative trains, closing unnecessary and money-losing stations, and staff reductions." We wondered, on reading this, what railway company, after the severe war restrictions, had restored unremunerative trains and reopened unnecessary stations. We now learn that the Great Eastern was intended, so it is due to that company that we should say that its situation is peculiar—it always has been, in many respects, a law to itself—and that the whole system is being carefully examined with a view to improved methods of operation being installed. These, it is certain, will not, however, reduce in any way the public facilities.

## Impact Effect Tests on Railway Bridges.

THE Advisory Committee appointed some time ago to revise the Board of Trade "Requirements in regard to the Opening of Railways," recognised that in dealing with impact effect on railway bridges, railway companies showed considerable divergence of practice. While a few of the companies make no allowance for impact, others vary the present permissible working stress of 6½ tons by an amount depending upon the length of the span or upon the range of stress to which the bridge is subjected by the live loads. In America the Pencoyd formula is largely used in this connection. According to this formula, the effect of impact is allowed for by increasing the live load by a percentage given by $I = 300/(300 + L)$, where L is the length of the span. The adoption of this formula was considered by the Advisory Committee, but it was decided not to recommend it without further evidence. The view was held by engineers that the Pencoyd formula did not provide sufficiently for small spans, and provided excessively for large spans. It was finally decided that the Ministry of Transport should conduct a limited number of experiments on the impact effect of live loads on railway bridges, with a view to verifying this view regarding the Pencoyd formula or to supporting some alternative formula.

A report on the experiments was issued on Monday by H.M. Stationery Office—price 15s. net. In all, 362 records were obtained from twenty bridges, situated on the South-Eastern, Great Western, North-Eastern and North-Western railways. The instruments used were of the Fereday-Palmer stress recorder type, invented by Mr. Fereday and lent by Messrs. Rendel, Palmer and Tritton. A fully illustrated description of the recorder is given in the report. It is sufficient here to say that it consists of a tube about 20in. long, provided with an electric lamp at one end and a fixed and a swinging mirror at the other. Light from the lamp, after passing through a slit, is reflected by the mirrors back to the lamp end, where it emerges through a second slit and is received on the film of a photographic spool. The beam from the fixed mirror is covered and uncovered in periods of one-quarter second by a clockwork mechanism, and thus gives a time graduated datum line on the film as it is wound by hand past the second slit. The swinging mirror is connected to a flexible leg carrying a hardened steel point, which is pressed against the member under inspection. Two similar, but fixed steel points support the lamp end of the tube. The image from the swinging mirror records on the film above or below the datum line the amount of tensile or compression strain in the member. The instrument is calibrated in terms of stress by applying it to a standard steel-specimen to which known loads are applied. Fluctuating stresses, varying as frequently as 350 times or more per second, can, it is stated, be recorded by means of the instrument. It would appear, however, that in the form used for the experiments it is capable of being somewhat improved, particularly with respect to the hand winding of the film and the steadiness of the datum line.

The report gives the figures obtained from all the experiments, and reproduces a selection of the more typical curves obtained from the bridges during the passage over them of trains of stated composition at stated speeds, varying from crawling to 84 miles an hour. The crawling speed record in each case is taken as showing the load imposed on the bridge by the test train without impact. The impact effect is expressed as a percentage of the crawling speed loading. In general it has been discovered that the secondary stresses recorded by the instruments are of considerable magnitude. Neglecting them, the observations when plotted would agree with the direction of the Pencoyd curve in a fair way, but would be 40 to 50 per cent. below it. Including the secondary stresses, the formula $I = 75 \div (L + 50)$ covers all the recorded points, omitting four exceptional cases. It does not, however, include certain points determined in the course of similar experiments on bridges of about 60ft. span, made by the American Railway Engineers' Association. To cover both the British and American results, the live loads should be increased to allow for impact by a percentage given by $I = 120 \div (L + 90)$.

The report, although far from being exhaustive or, in our opinion, conclusive, contains a very great amount of valuable information for railway and bridge engineers, not only in connection with impact effects, but concerning other matters of prime importance.

## Letters to the Editor.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

### LOCOMOTIVE FOOTPLATE EXPERIENCES.

SIR,—The series of articles on "Footplate Experiences" have, I am sure, been read with the greatest interest by al locomotive men. They afford some insight into the diversity o practice and conditions on the various railways of this country Your representatives give a general description of each run and recorded all the more important observations. But, in the absence of anything like a complete catalogue of every movement of the driver and fireman and the fluctuations of the various gauges, it is not possible to draw any close comparisons, even between runs made by the same engine.

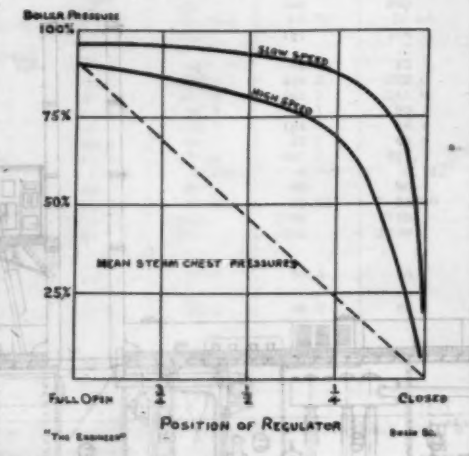
In an editorial article you draw attention to some of the apparent anomalies, and point out the differences in working the engines. One driver has the regulator half open and a long cut-off; another opens the regulator full and notches up more. I suggest, Sir, that too much importance is attached to the position of regulator and reversing lever when making comparisons. Except at slow or very moderate speeds cut-off is a purely nominal event; it is difficult to find on an indicator diagram the actual point at which the valve closes the port. Regulator opening is relatively unimportant; what is of importance is steam chest pressure, and the difference between this and boiler pressure depends on the velocity of steam through the diaphragm opening presented by the regulator.

For a given opening this drop becomes greater as the demand for steam by the cylinders increases; that is to say, it depends on the horse-power developed, or, rather, on the steam consumption itself. Except with small regulator openings, indicator diagrams taken from one engine for the same cut-off and speed show that there is little or no difference in the M.E.P. and horse-power whether the regulator is full open or only partly open. It would, therefore, appear that the area through the regulator ports, as provided, is ample.

On many modern engines the regulator handle is brought within easy reach of the driver by means of an extension of one kind or another. Without these extensions the handle is out of easy reach from the right-hand side when beyond the vertical position; that is to say, when more than half open. Hence there is a reluctance on the part of the driver to open the regulator fully, especially on fast trains, in case of meeting adverse signals.

It is often thought that when a regulator is half open the mean pressure in the steam chest is about half of that in the boiler, as indicated by the dotted line on the accompanying diagram. Actually, the mean pressure will vary somewhere between the limits indicated for high and slow speed, depending on the steam consumption. The diagram is only very approximate, and is not based on any precise data but on general observations only.

With regard to cut-off, here, again, the position is purely




nominal. I quote below, in tabular form, an actual case showing the difference in working of two superheater engines having approximately the same diameter of wheels, equal loads and speeds, and running over the same section of road, and even handled by the same driver and fireman. The only important differences between the engines lie in the cylinder diameter, valves and boiler pressure.

| | Engine A. | Engine B. |
|---|---|---|
| Cylinder diameter, inches | 19 | 20½ |
| Boiler pressure, pounds per sq. in. | 180 | 160 |
| Piston valves diameter, inches | 10 | 9 |
| Regulator opening | One-third | One-half |
| Cut-off, per cent. | 17 to 25 | 30 to 35 |

The regulator opening in the case of engine A was rather less than B, tending to equalise steam-chest pressures. Then what is the explanation of the cut-off of engine A being apparently so much less than that of B? Since the engines are of the same type and general dimensions, it could not be said that one ran appreciably less freely than the other, so that their indicated horse-powers were equal. Engine A has not only larger piston valves, but smaller cylinders; hence the ratio of port opening to cylinder area is more generous. In addition, the valves have larger lap and consequently longer travel than those of B for the same cut-off. As a consequence the valves of engine A open more fully to steam, cut off more sharply, and give a full opening to exhaust, so that an indicator diagram would have as large, or larger, an area as one taken from B with a nominally longer cut-off. Therefore, I maintain that actual cut-off is unimportant; what the driver does is to alter the shape of the indicator diagram by the reversing lever.

In your editorial article you advocate the shortest possible cut-off as giving the greatest economy. But is this so? Systematic tests seem to show that the minimum steam consumption per indicated horse-power occurs with a cut-off of about 25 per cent., and that the minimum consumption per draw-bar horse-power is more like 30 per cent. The internal resistance decreases as the turning moment becomes more even. Crank pin pressure, however, depends not only on cylinder pressure, but on inertia forces as well. Hence the weight of reciprocating parts and speed complicate the problem.

My experience of engine-drivers may be exceptional, but, generally speaking, the best men have little to learn, and it is these men who set the standard for the rest. I find them so keenly interested in their work that they freely exchange views and experiences with one another, and they may be trusted to get the best all-round results possible. Increased efficiency lies more in improving the engine than the driver. H. H.

July 17th.

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RESEARCH.—The Research Association of British Motor and Allied Manufacturers, of 15, Bolton-road, Chiswick, W. 4, has entered on its second year of activity and is now in a position to extend its experimental work. A new laboratory recently built is now practically equipped and a staff of scientific workers has been engaged. At the annual general meeting, held in June, Mr. H. C. B. Underdown, chairman and managing director of Commercial Cars, Limited, was elected president, and the following were elected vice-presidents:—Sir Dugald Clerk, K.B.E., F.R.S.; Lieut.-Colonel J. A. Cole, managing director of Humber, Limited; and Dr. F. W. Lanchester, M. Inst. C.E.

CONTRACTS.—The Tees Side Bridge and Engineering Works, Limited, Middlesbrough, after keen competition with German and continental firms, was successful in securing the contract for the masting of three vessels being reconditioned at Antwerp. The work consisted in the supply of three funnels, three sets of masts, six large derrick posts and ventilator cowls and fittings. The contract time for completion was five weeks, but the work was actually carried through in three weeks.—The Turbine Furnace Company, Limited, has received from twenty separate companies and undertakings orders for turbine furnaces. The furnaces are for application to Babcock and Wilcox, Davey-Paxman, Lancashire, Cornish, and marine type boilers.

## Provincial Letters.

### THE MIDLANDS AND STAFFORDSHIRE.

*(From our own Correspondent.)*

#### Dear Fuel and Iron and Steel Prices.

A GREAT outcry continues throughout every branch of the iron and steel trades in this part of the kingdom against the dear fuel conditions which ironmasters are faced with. It would almost seem that there is no possible escape from this most unsatisfactory position. Those branches of the industry which have been re-started will be idle again very shortly unless additional orders are forthcoming and fuel prices are reduced. Forge and mill owners are determined to proportion their output strictly to the visible needs of the market. Further, it is obvious that the only condition on which trade can be got into full swing again is a reduction in coal and coke prices. At present the market pace is being made by the continental producer, who is offering many descriptions of iron and steel at £4 and £5 below the prices at which they can be produced here. Most of the business waiting to be placed is contingent also upon further concessions in iron and steel prices. Unless ironmasters are prepared to be satisfied with smaller profits than in the past there is little chance of securing contracts against the competition of continental producers. Now that the atmosphere is clear of strikes it is earnestly hoped that fuel prices will adjust themselves and give some encouragement to Midland iron and steel masters to re-start the mills and forges. The law of supply and demand is looked to for the rectification of coal and coke prices, but it will take some months probably to make its influence effectually felt. Meanwhile the iron and steel industry will "go slow." When one bears in mind the fact that it is estimated that it costs between £2000 and £3000 to re-start a blast-furnace once it has been blown out, it will be readily understood that manufacturers desire to see some continuity of trade before they rekindle their furnaces. Orders will not materialise at the old level of iron and steel prices, and the co-operation of the coal industry is necessary if prices are to be further lowered to any appreciable extent. No one living has ever known such a period of stagnation in the iron and steel trade market as the present. The trade deflation which began last autumn has made rapid progress during the present year. It has entailed disastrous conflicts with labour, which have seriously retarded the attempts to recover balance in face of the adverse operation of the continental exchanges.

#### Staffordshire Marked Bars Down Again.

Staffordshire marked bars are again down £2 per ton, making a total reduction since the year opened of £13 10s. The last reduction was only slightly over a month ago, when prices fell at one step from £27 10s. to £22. Now the odd 40s. has been taken off, and best Staffordshire iron reaches the level figure of £20. This is considered something like a reasonable relation to unmarked iron at £13. Manufacturers of best bar iron are now in a posion to get on with orders held up by the strike, and with the reduced price the outlook in this branch is reasonably hopeful. Unmarked bars, which were reduced at the end of last month to £16, are neglected save for varied specifications received from merchants who want to fill up the gaps in their stocks. The forges and mills of the district producing crown bars are all reported to be idle, as they cannot make and sell iron at £13 per ton while coke remains at its present price. A report in circulation that Lancashire proposes to make a further cut of £2 per ton, has been received with some consternation, in view of the helpless condition of the local manufacturers. It is pointed out that Lancashire apparently no longer observes the understanding that price settlements should be of a national character. The much-needed relief in fuel is not yet forthcoming, prices charged by local collieries to ironmasters ranging from £1 10s. to £1 15s., the figure prevailing before the strike. Nut and bolt manufacturers have only enough work to employ them two or three days a week. They are under no necessity to buy raw material, and if they were they could get Belgian bars at something like £11, delivered in the Black Country, so that there is not much inducement to re-start bar mills with a view to orders from the nut and bolt trade. Chain and cable makers are doing very little, and there is hardly any demand for the special iron which they employ. Continental quotations for iron bars, delivered in Birmingham, are as low as £10 10s. and £10 5s. Before the war unmarked bars were being sold at £6 10s. To-day the official quotation is £16, and millowners say that when all the other enhanced costs are added to the price of coal the trade is not worth having. Belgian bars are delivered here at £11 and even less. It is not surprising, therefore, that with the diminution in the general volume of trade our own mills are unemployed. A considerable order for merchant bar iron has recently been placed from this district for Ireland. The iron strip mills are idle, and the price quotation of £20 per ton is but a nominal one. Iron strip is now the same price as best bar iron. The prospects in the galvanised sheet trade seem less encouraging than they were a week or two ago, and the resumption of production is very partial. During the past week some of the firms in the iron and steel trade have started to employ men on work preparatory to resumption in expectation that coal will shortly be forthcoming at a price which will enable them to meet would-be customers.

#### Attempts to Beat European Steel.

In the confused state of the market it is difficult to establish any values for British billets; prices have varied from £8 10s. to £11, according to quality. The only activity is in connection with imported material, half products and finished descriptions. Some of the re-rollers here are making a bid for the market by taking advantage of the low-price billets which Belgian merchants are offering. The number of these mills in operation

tends to increase. Soft billets can be obtained at about £7 7s. 6d., and as it is possible to sell the bars at from £13 upwards, this class of business can be carried out at a moderate profit. There is, however, some competition in this branch, and prices have a falling tendency. Germany is securing some small orders for ship plates at less than £11, against the home price of £15. Belgian houses are trying for this trade, but cannot meet the cutting tactics of the Germans, who are quite £1 below their continental neighbours. Our steel bar mills are following up their attempts to wrest the trade, or some part of it, from the foreigner, and are quoting down to £12 10s. Lancashire firms are quoting £14 10s. for steel bars, but business can be done in the Darlaston district at £12 a ton. The higher-priced bars are rolled from English billets, the lower-priced ones presumably from continental billets. Billet makers have not been producing for a good many weeks past. Sales have been from stock, and the scope of the market has now become very limited. Steel strip makers in this country and on the Continent are dividing the business between them, prices being cut very fine for qualities suitable for gas purposes. £13 10s. to £15 is the Midland quotation, and Belgian shippers are well within these figures.

**Pig Iron Famine.**

Pig iron gets scarcer every week, especially the foundry brands used in this district, and we are threatened with a veritable famine. It is confidently predicted that this iron will be dearer for some time, though a fall eventually is recognised as inevitable. There is no prospect of the production of pig iron for the open market to any extent. No blast-furnace has been started in this district since the strike, and ironmasters are less concerned than usual to get to business, because the very hot weather discodrages enterprise in the starting of ironworks. The general view of the works managers is that the workmen could not possibly operate the mills and forges under the heat conditions of the past week. It is understood here that four blast-furnaces will re-commence shortly on the North-East Coast, and one Nottingham firm is stated to have announced its intention of starting a furnace. As only one of these is likely to sell pig iron in the open market, the others requiring their pig iron for their own mill, there is not much relief to be expected from these sources. Smelters continue to be employed inquiring as to future coke prices, but without satisfactory results. The fuel question is the pivot on which everything turns. One smelting firm which sent out a series of inquiries as to the price of coke, received no quotation below £3 17s. delivered, which is quite an impossible figure from the point of view of profitable production. A Welsh coke-making firm, a little more anxious than other people to do business, quoted £3 per ton, but followed it with a tentative inquiry as to what coke users will be prepared to pay. The figure of £1 10s. has repeatedly been mentioned, and it is thought just possible that some furnaces might risk a re-start at an outside charge, including carriage, of £2 to £2 5s. per ton. At present there seems no possibility of bridging the gap, and with this, the hot weather and the approaching holidays, some firms have postponed any decision to re-start until the beginning of September. It is suggested that in view of the undoubted famine in pig iron, which is rapidly developing, prices of standard bars are likely enough to increase in value, for a time at least, and if this should take place, the smelter might be reconciled to somewhat higher coke figures than he would otherwise be prepared to pay. A certain amount of Cleveland forge is reaching the district at £6 2s. 6d. f.o.t., which is about the price at which Belgian forge can be obtained here, while some lots of Belgian foundry are offering at £7 5s. There are really no local quotations which would serve as a useful guide.

**Drop in Tinned Sheet Prices.**

At a meeting of the Tinned Sheet Manufacturers' Association on the 15th, prices were reduced 6s. per cwt. Best charcoal now stands at 64s., charcoal 62s., coke unassorted 58s., to 20 gauge.

## LANCASHIRE.

*(From our own Correspondents.)*

MANCHESTER, Thursday.

**Iron, Steel and Metals.**

TIME passes without bringing any definite change in the condition of the iron and metal markets, and it is noticeable that those who looked for improvement as an immediate consequence of the industrial peace are fewer than they were. In iron trade circles the more prevalent idea now is that we must struggle through at least another six months before things can be put right and business can be resumed on a fair scale of magnitude. The difficulties in the way of progress were much more numerous and more complicated than was at first supposed, and even with goodwill between employers and employed much time must be allowed for recovery.

**Metals.**

The market for the non-ferrous metals is very much as it has been for some weeks. There is no sign of increasing demand yet in the home market, although Germany has taken a good deal, quite as much, if not more than might have been expected. It is a little contrary to our notions of poetical justice that Germany—the worst of the criminals in the late war—should be the first to recover from the industrial disaster following on the war. There has not been much change in the market for standard or for refined copper. The speculative market is rather inclined to weakness, perhaps on account of the depressed feeling in America, which may, however, be temporary. We have commented several times on the disparity between raw and manufactured copper and brass prices, and last week—without any definite alteration in raw-copper prices—the official quotation for copper sheets was reduced by £5 per ton. One would like to know whether this is a preliminary to the process of bringing all the prices for manufactured metal into proper relationship with raw copper, tin, and spelter. The consumer of flat copper bottoms, for instance, resents being constantly told in his market reports that the price of tough ingot copper is £72 or £73 per ton, and then being required to pay £122 per ton for bottoms. Now he is asked for £117 only, and £107 for strong sheets, but he sees that spelter is rolled into zinc sheets at a cost of £10 over the price of the raw metal, while £35 is wanted for rolling copper sheets. There is just now a very great number of what may be called "price anomalies," and the copper and brass trade has its share of them; although there are other trades similarly afflicted. Tin is still a fairly steady market and the fluctuations keep within very narrow limits. It is a little curious to note that whereas the market feeling was fairly optimistic right through the coal strike, it has now changed, just when one might have supposed that optimism was reasonable. Lead has been in very good demand lately, and the fall which the market looked for has been postponed for the present. Spelter is quiet and steady, but the position is still very obscure.

**Foundry Iron.**

The position in the market here is practically unchanged, and there is very little iron being offered. For British iron, when there is any, sellers generally ask about £9 per ton delivered in Manchester, but as a rule founders cannot pay such a price. One or two firms here are carrying on with foreign pig iron, and this side of the business is growing. It is claimed by some founders that they can get workable foreign pig iron at about £5, but this is probably only in rare instances. Probably, however, at £6 a good deal of foreign iron can be obtained, and in any case the foundry business cannot be carried on here unless iron can be obtained at something like this price. The blast-furnaces are not starting except in one or two instances, and the price of coal and coke does not come down in spite of lower wages and a £10,000,000 subsidy. One Derbyshire furnace is to be blown in next week, according to report, the idea being perhaps that there will be a market for a small quantity at £8 10s. or £9, although there would be no market for a large quantity.

**Finished Material.**

There is very little business here in finished iron and steel, and many of the works have not started yet. There is, of course, no hope of competing with foreign material, and buyers are very cautious about paying the prices which British manufacturers are forced to ask. A larger market might lead to easier prices, because the cost of producing might be less; but what is needed, first of all, is a reduction in fuel costs, and this we do not get.

**Scrap.**

Dealers here still quote £6 5s. to £7 for good machinery cast scrap, but there is now very little business. Heavy wrought scrap and steel scrap remain nominally at £3 to £3 5s. per ton, but there is no selling or buying at present.

**Unrest Amongst Transport Workers.**

A meeting of transport workers was held in Manchester last week to listen to an address by Mr. E. Bevan, who is provisional secretary of a new organisation called the National Transport and General Workers' Union, which compriaes seventeen other workers' unions. The chief object of the meeting was to emphasise the benefits of co-operation in order to resist impending proposals for wages reductions. One of the troubles with which this branch of labour is at present beset is that of working hours. It appears that the working week has recently been one of forty-eight hours for transport workers in Manchester, and this time included the time occupied in garaging and stabling horses, variously estimated at between half an hour and one hour per day. The employers are now seeking to bring about some change in this respect by placing the garaging and stabling outside the working forty-eight hours, and it is reported that one of the unions involved, namely, the United Road Transport Workers' Union, has practically accepted this condition. In view of the general condition of the carrying trades, the new arrangement may be considered quite reasonable. It has for a long time been felt that the transport workers' hours have been unduly short, all things considered, and have tended in no small measure to aggravate delays and to cripple industry in general, and it is high time that impediments of this nature should be removed as far as possible.

**The Textile Industries.**

It is pleasing to be able to report one branch of industry in which there are distinct signs of improvement. At a meeting of the Egyptian Section of the Federation of Master Cotton Spinners' Association, held last week in Manchester, it was decided to remove at once the restriction hitherto in force with regard to the working week, namely, four days. The section of the Federation using American cotton has also decided on a more moderate extension from twenty-four hours to thirty-five hours per week, and in future the position will be reviewed at fortnightly intervals. These decisions will tend to have a beneficial effect on the allied industries of Lancashire. Short time has now been in force in the cotton industry since October last.

**The Apprentices' Strike.**

The strike of apprentices in the engineering trade which commenced about three weeks ago in consequence of the proposed reduction in wages, has ended, as everyone foresaw that it must eventually end, in collapse. The scale of wages paid to apprentices before the war varied between 8s. per week at fourteen years of age to 20s. at twenty years of age. To these wages war bonuses have been added varying from 10s. 9d. per week to seventeen years of age and 26s. 6d. per week from eighteen upwards. From these figures it will be seen that there was a difference of roughly 10s. per week between the boys of seventeen and eighteen, the latter of whom were earning as a minimum 41s. 6d. per week, to which is to be added in some cases piecework benefits. It was in consequence of the employers' decision to reduce the bonuses paid to the apprentices that the strike originated. Under the scale which now will come into force the total earnings will vary between 14s. 8d. at the age of fourteen to 22s. at the age of seventeen; the difference in wages and bonuses between the ages of seventeen and eighteen will now be something over 6s., whilst lads of nineteen and twenty will receive altogether about 34s. and 40s. respectively. Considering the state of the engineering industry at the present moment, the new scale of payment seems to be quite adequate, especially when it is considered that youths are generally living with their parents, who receive only a small proportion of the total earnings.

BARROW-IN-FURNESS, Thursday.

**Hematites.**

The position in the hematite pig iron trade shows no change on the week. There is inactivity throughout the entire district, and for the present there is no sign of a start at any of the works in the immediate future. Conditions generally remain unsettled. It is impossible for smelters to put their plant into operation until they are assured that raw material, chiefly coal and coke, are obtainable at a price that will enable them to quote terms to buyers that will induce business. The price quoted for the past few weeks is considered far away too high by those in search of iron, and business is very much in the background. It is known that requirements are good on local as well as general home account, but contracts can only be secured in face of competition at low values.

**Iron Ore.**

Apart from a few men employed at the Pennington pit in North Lancashire, there is nothing being done in iron mining, and there have been no arrivals of foreign ore for many weeks.

**Steel.**

The only activity in the steel trade is in the rolling of hoops at work. Two of the mills at the Barrow Hoop Works were got to work last week and are now running. The foundries are fairly well employed. The whole of the steel producing plant remains idle and business is entirely in the background at present. September is now talked of as likely to see the re-start, but that will depend upon circumstances.

**Shipbuilding and Engineering.**

These trades are on short time and work is very slack in some of the departments, with some contracts entirely held up owing to the heavy cost of production.

## SHEFFIELD.

*(From our own Correspondent.)*

**Reviving Activity.**

IT cheers one to observe the steel works here, large and small, gradually returning to activity, and to notice the central thoroughfares, in the same ratio, being cleared of men standing idle, but longing for work. Operations are being renewed as quickly as possible at the armament works, though nowadays precious little meaning is there in the description "armament." In pre-war times fully 50 per cent. of the production of these firms was of a peaceful character, and now output of a warlike nature has fallen to an almost negligible percentage. The departments, however, with their costly plant and machinery, are still maintained in first-class running order by means of skeleton staffs, and it is confidently anticipated that before the end of the present year this precaution will have, to some extent, been justified. With the strongest League of Nations and the greatest desire for disarmament, an Empire with such immense coast lines as ours to defend will have to build warships, and nothing in the shape of a capital ship has been put into the water since the launch of the Hood on the Clyde, whereas naval demobilisations have been on a very extensive scale. The laying down of four battleships will mean a distinct revival in Sheffield's heavy plate and ordnance departments, and as soon as things settle down, Japan will not be the only foreign Power to place armament contracts in this country. For the moment, however, the hope of industrial recovery in these districts lies not in armaments, but in the production of steel and machinery for the development of peaceful trades, and it is in that direction Sheffield is now advancing.

**The Late Mr. Henry Steel's Policy.**

Since my previous letter I have had a note from Steel, Peech and Tozers to the effect that they are resuming operations in the Siemens and Bessemer steel melting departments, which, it may be mentioned, have been standing idle since October last in consequence of undercutting by the Continent—a matter that was explained at the time very fully, if I remember rightly, by Mr. Albert Peech, in a letter, in the course of which he drew attention to the unfair position in which our steel makers were placed by the unbalanced exchange rates. This re-opening at the Ickles means employment for at least 1000 men at once, and for another 1000 almost immediately, but from what I hear it may be some little time yet before work is resumed on any appreciable scale at Templeborough. The great desire of the late Mr. Henry Steel—and I heard him express it not very long before his death—was that the Morgan continuous wire rod rolling mill should solve the problem of how to combat continental competition in that kind of production which, up to the outbreak of war, was making very deep inroads on our market. Since then, for reasons all too well known, that competition has been renewed with greater keenness than ever, so that although soft wire rods have been "cut" to £13 5s., our price is still 60s. or 80s. above offers from Belgium. But it is only a question of time and tenacity, just as it was

in the war years. The solution will yet come, I believe, from Templeborough. The original plans of the late Mr. Steel may undergo a little revision, no doubt, but in the main his great scheme of co-ordination between the range of fourteen or fifteen 60-ton steel-melting furnaces and the huge rod, merchant bar and strip mills, with the cogging mills and the rest of the plant laid down in recent times, will play a very important part in the re-establishment of British steel in the home and overseas markets.

**The Closing Down of Jessops.**

Of the armament works, John Brown's, perhaps, were the least affected by the coal strike or the trade slump. I am not suggesting they were not affected, because they were, and very seriously too. In fact, Sir William Ellis, one of the managing directors, has spoken very plainly to workers of the urgent necessity of co-operating with employers to ascertain some means of so reducing the cost of production that vitally important, but lost, trade may be re-attracted to Sheffield. Now, however, all these companies are slowly but surely recovering their ground, and it is a source of gratification to observe how that is being applied to the case of Vickers' works. When these works are running on something approaching normal lines again—and it may not be long—a considerable absorption of the unemployed will have taken place, for the works are very large. One of the disappointing features of the situation is the entire closing down, for the present at all events, of the famous works of William Jessop and Sons, Limited, a name associated all over the world with the production of very high-class steels. Was it not Jessop's steel that was singled out during the war for special commendation as the correct material for the making of those clever contrivances that saved so many of our ships—paravanes? Two years ago Jessop's works, with all the company's foreign connections, were acquired by the Birmingham Small Arms concern, and whether or not it is that, as in the case of many such absorptions, it has been decided by Birmingham to close down the Sheffield works as part of a policy of more economical working, I do not know. The only thing certain is that the works have been definitely closed down, with the result that about 1500 men are permanently unemployed—though there is a suggestion that Jessop's may be re-opened when trade revives. May the event be hastened. In the meantime all other Sheffield steel firms seem to have girded up their loins for participation in the coming life-and-death race for trade, and—well, Sheffield has always won through so far.

**Good Order for Cravens.**

A few days ago the management of Craven's Railway Carriage and Wagon Company, Limited, of Darnall, Sheffield, informed me that a contract has been placed with it by the British Petroleum Company, Limited, for no fewer than forty-five oil-tank wagons of 14 tons capacity each. Craven's is an instance, like Davy Bros., of Sheffield firms that have had no particular reason to complain of the trade slump, for though in neither case is new business coming forward at all freely, both firms have sufficient orders on their books to carry them on for a long time yet—so far as Craven's is concerned, until well over into January, I believe. By that time—and, let us hope, long before then—the tide of trade activity will have set in again, and meanwhile occasional orders are drifting in, such as that for oil-tank wagons just mentioned, and some quite important new business recently secured by Davy's and referred to in a previous letter. Other examples of the kind could be quoted, but perhaps these suffice to show that if the trade recovery here is slow—tediously slow—things really are moving toward an improvement. Some of the main line railways, I hear, are beginning to place quite considerable requirements over the next quarter in the way of railway steel and certain tools, especially files, and notwithstanding the slump in the shipyards there is talk of one of the large Sheffield firms having booked a contract for propellers and shafts of a kind that must be designed for a craft of high tonnage, to be built on the Clyde.

**Russia Buying Again.**

Hadfield's fine new steel foundry is getting well under way, which reminds me that forges generally here seem fairly well placed for work of the lighter sort, but rolling mills will require to secure a substantial amount of new business in the very near future if they are to keep up the activity they are now enjoying on account of local commissions. Basic steel furnaces will probably experience an extremely slow recovery, and there are still many open-hearth furnaces cold. In the crucible steel department there are signs of revival, though by no means pronounced at present; nevertheless, new business is certainly coming forward, some, as I hinted in last week's letter, being on Russian account. Toward the close of the war and for some little time afterwards, makers were rather badly hit from that quarter, so that any new transactions with Russia, I should imagine, will only be entered into with strong guarantees. Tools and light iron and steel work for the building trade appear to be called for just now fairly freely, and the demand for joiners' and engineers' small tools seems to keep strong. Russian interests are credited with having placed a large order here for cross-cut saws, of which delivery could be given immediately, the contract being filled from stock, and when once the high-speed steel market recovers, makers will be enabled to satisfy the early demands pretty quickly for the same reason, there being large amounts of money locked up, I believe, in stocks of that kind—in fact, I have seen the well-filled shelves of some of the warehouses.

**Mr. Hichens' Letter.**

Last week I referred to the contract for electrical plant which the Sheffield Corporation proposed to place with Germany, and in the "latest news" column was able to mention that the scheme met with such opposition that the Corporation had referred the matter back for further consideration. But the opposition was not permitted to reach the stage of a hot debate at the City Council's monthly meeting last week, as had been anticipated, for the Committee responsible for the recommendation apparently foresaw trouble, and anticipated it by taking back the proposal for further consideration, which, no doubt, means that the contract will now be placed in this country. It is, perhaps, fair to assume that the deciding factor was a letter from Mr. W. L. Hichens, chairman of Cammell, Laird and Co. "I understand," he wrote, "that the Sheffield Corporation are proposing to buy from Germany a 10,000-kilowatt set for their electric power station, on the ground that the German prices are lower than the British. Speaking generally, I accept the principle that it is right to buy in the cheapest market, and that British industries must bring their prices down to competitive levels if they want orders. At the same time, this case is somewhat exceptional. The contents of a turbine, as you know, are largely forgings and discs, which are manufactured in Sheffield. At present there is very serious unemployment in Sheffield, and I am told—I hope wrongly—that the rates will be very materially increased to meet the costs of the emergency. The factories of Sheffield will be called on to contribute largely to the rates, but it is difficult to see how they are to meet the bill if they have no work to do. High rates, I would remind you, are an important factor in handicapping us against the Germans, and the policy of the Council would appear to be to increase unemployment and thus swell the already swollen rates. Thus we go round in a very vicious circle. I would suggest that it would be in the interests of Sheffield if this particular order were placed in England on the understanding that the forgings and discs are ordered from Sheffield. If the City Council is going to set the example of buying the special products of Sheffield abroad it is difficult to see how other corporations can be persuaded not to follow their example. An ounce of practice is worth a ton of theory, and I suggest, by placing this order abroad, the Sheffield City Council will undo all the good that their active propaganda on behalf of Sheffield's trades has effected." The German price for the plant was £49,900, including the cost of erection in Sheffield, and at the time of its proposed acceptance the nearest British offer was some thousands of pounds higher. The chairman of the Electric Supply Committee, however, now says that the publication of the facts has done a certain amount of good in the country in that prices have come down. And so, presumably, the matter ends.

## NORTH OF ENGLAND.

*(From our own Correspondent.)*

**Re-Starting Industry.**

THE process of setting the wheels of industry going again, after the demoralising period of idleness occasioned by the miners' strike, is beset with enormous difficulties, but the progress made so far on the North-East Coast must be regarded as very satisfactory, having regard to all the circumstances. The greater part of the collieries in Northumberland and Durham have recommenced operations. The output is increasing, but has not reached the normal average per head. The present week is expected to show considerable improvement. Unfortunately, the fact that fuel is now available does not necessarily mean an early resumption of work in the iron and steel works. Owing to the length of the stoppage a large number of furnaces have gone cold, and it will be very difficult, and in some cases almost impossible, where the furnaces are old and the linings none too good, to start them up again. Apart from mechanical causes, however, a general resumption is dependent upon economic considerations. Iron and steel makers make no secret of the fact that they do not intend to put their works into full operation until working costs have been considerably reduced. During the past few weeks they have secured some relief by reductions in wages, but fuel is the decisive factor in costs, and until coke and coal becomes much cheaper furnaces are not likely to be blown save very gradually. The engineering and shipbuilding trades are being restored to activity, but are handicapped by a shortage of materials.

**Cleveland Iron Trade.**

The Cleveland iron trade shows but little signs of opening out. As a matter of fact, the market is quite void of activity. The little foreign inquiry that is reported leads to no business, because our prices are too high, and the home demand is satisfied by very small parcels. There has at last been re-commenced the production of pig iron, and so far as can be ascertained five blast-furnaces are now in operation, but in each case the output is earmarked for steel making, and none will come on the market. Cleveland ironmasters adhere firmly to their resolution not to resume working the furnaces until there is a prospect of balancing costs of production with selling prices, and they clearly recognise that both must fall if lost foreign markets are to be recovered. Blast-furnacemen's wages have undergone a drastic cut. The Cleveland miners, who have already suffered a reduction of 5s. per day, have been asked to accept another heavy reduction, and thus labour is sharing in the sacrifice. But coal is still far too dear to make pig iron production a paying proposition. However, keeping the furnaces idle will gradually have its effect, for they are big consumers of fuel, and if there be no demand prices will necessarily fall. As a matter of fact coke prices are a little weaker, and good average blast-furnace qualities have been offered at 45s. per ton delivered at the works, as against a maximum of 45s. per ton at the ovens a week ago. Still a much bigger drop is needed before the ironworks can re-start. Meanwhile the official quotations are unchanged, and the few holders of Cleveland foundry iron continue to ask 15s. per ton above the minimum, No. 3 and No. 4 foundry both being quoted 135s., as against 117s. 6d. per ton for No. 4 forge and mottled and 115s. for white iron. There is no No. 1 on offer, and for other foundry qualities 5s. per ton above the home price is quoted for export orders.

**Hematite Pig Iron.**

Extreme quietness prevails in the East Coast hematite pig iron trade. No furnaces have yet been put into blast. Next to no business is being done. Even the offer of mixed numbers at 140s. per ton f.o.b. fails to attract foreign buyers, and the home demand for hematite is extremely limited, buyers objecting to pay 100s. when it is offered abroad at 20s. per tonless.

**Iron-making Materials.**

There is no market for foreign ore. Consumers hold heavy stocks bought at high prices, and in many cases have substantial unexpired contracts which they must complete when the works get going, so that they are not likely to come on to the market for some time.

**Manufactured Iron and Steel.**

Activity at the steel works is increasing as coal supplies improve, and a good many men are now back at work, chiefly at the mills. Some of the works have still a fair volume of orders to execute, and there are some large cargoes awaiting shipment, so that the returns for July are likely to show improvement. Foreign competition is, however, keen and new orders are very scarce indeed. Home prices, though inclined to droop, show no change on the week, but for export makers are keen to cut prices in the hope of securing business.

**The Coal Trade.**

There are now signs of the approach of more normal conditions in the Northern coal trade. The collieries are gradually getting back to a normal working state, and the output is daily increasing. The market remains very firm for all classes of coal when spot or early deliveries are required. The collieries are favourably placed for the rest of this month and the early part of August, and for this class of trade high prices are frequently paid, as much as 50s. for best steams, with other classes quite 5s. above the nominal quotations. These figures are, however, quite fictitious and are not possible for any forward date. As a matter of fact there are clear evidences of the approach of something like a normal market, and with as low as 32s. 6d. and even 30s. repeated several times for good Durham unscreened for delivery over the rest of this year, it looks as if the present rush is giving signs of falling away. The primary reason for high figures is the heavy home demand, but when stocks are once more replenished the exporters will then get a chance. There is still a fairly heavy and constant stream of inquiry from the Continent and also South America and the coaling stations, but not much business as yet is being contracted for owing to the prices being too high. A disturbing feature of the situation is the lack of disposition on the part of the foreigner to pay the present prices, and as a consequence the export figures for forward shipment are not quite so rigid and will undoubtedly have to come down once there are free supplies in any bulk on offer. When the quotations are sent forward the inquiries are usually withdrawn for the present or else nothing more is heard of them. The coke market remains more or less nominal, in the absence of supplies, though there is a steady call for all the usual classes.

**Ironstone Mines at a Standstill.**

The position of affairs in the Cleveland ironstone mining industry is causing a great deal of anxiety, not only to the owners, but also to the workers. There is little prospect of a general opening of the mines until working costs are considerably reduced. As it is, the industry is at a standstill. Most of the iron-producing firms declare that they cannot afford to smelt Cleveland ore at its present price. The question of the Cleveland miners' wages, which have been deferred until after a settlement was reached in the coal industry, was again reviewed at a meeting of the mineowners and miners' representatives on Monday. The subject was discussed at considerable length. Finally the owners offered terms, representing a reduction, and promised that if these terms were accepted the mines would be worked to the fullest possible extent. It has been decided that the terms should be submitted to the men. The decision of the district—taken by lodge voting—will be communicated to the employers, and a further meeting will be held, if necessary, on Tuesday, August 2nd.

## SCOTLAND.

*(From our own Correspondent.)*

**Unemployment of Miners.**

A LARGE number of miners are finding it no easy matter to regain employment. All districts in Scotland are more or less affected, but in Lanarkshire the situation is most serious. Here some sixteen thousand miners are still "out," and there is little prospect of the big majority getting back to work for a considerable period. Miners in Lanarkshire were at work last Saturday, which is quite an unusual experience for them, Saturday being generally an off day. In this district also some pits are being dismantled, while at others the necessary repairs have not yet been begun. The news from Fifeshire is somewhat better, however. At least one additional colliery has re-started employing a few hundred men, and it is said that others are almost ready to re-start.

**Unemployment Benefit Refused.**

Difference of opinion exists as to whether or not miners now unemployed are entitled to unemployment benefit. Test cases were sent forward from three collieries in Lanarkshire. The claim has been refused in each case on the ground that the unemployment is a direct result of the recent stoppage. The Miners' Union is not prepared to accept such a decision, and the whole question will probably be discussed before a Court of Referees.

**Movement Against Officials.**

For some time back there have been signs of dissatisfaction amongst Lanarkshire miners with the officials of the County Union. These signs have now taken a definite shape. A meeting was held at a Blantyre colliery,

when it was resolved that the men should withhold payments from the union offices until they have the right to elect officials and agents by ballot. Similar resolutions have been adopted at other collieries in Lanarkshire. Under the present constitution the miners have no say in the appointment of officials, but they now demand that these positions should be vacated immediately and nominations made from all districts in the area with the object of putting the union on a modern basis. The miners further demand that these positions should be balloted for every six months.

**Trade Outlook Improving.**

Though reports from the mines leave little room for enthusiasm, news from other quarters is brighter. There appears good reason to assume that better times are in prospect in the steel trade, and perhaps sooner than was anticipated. At any rate, notifications have been made of an early re-start at several large works, and although these may not be of the fullest nature, the change for the better gives cause for satisfaction. Work has already been begun in one establishment in which at least one rolling mill has been out of action since last Christmas. At the works in question it is estimated that of the total number of workers, amounting to upwards of 5000 men, fully 50 per cent. will be in action by the beginning of August. The situation at the pig iron works is a serious hindrance to an all-round resumption, and until cheaper fuel is available the position is not likely to advance in this direction. Imported material must, therefore, supply the needful until the questions of rates of exchange and other matters readjust themselves.

**Finished Steel and Iron.**

The past week was largely under the holiday influence, and this week a complete stoppage will be recorded for the same reason. Generally speaking, a resumption is not looked for before the end of this month. Order books are very light, and there is every inducement to prolong the stoppage until fuel supplies and prices are more favourable.

**Coal.**

The coal markets still show a state of comparative inactivity. For various well-known reasons the supply of coal is totally insufficient and quotations too high to make transactions possible on an ordinary scale. A few transactions with Irish buyers are again reported, but for this trade the prices of English fuel are said to be more favourable than Scottish quotations. Railways are taking good deliveries, and utility concerns also are laying in fair stocks; but otherwise there is very little being done. A small turnover in bunkers, however, has been reported. Prices remain rather indefinite, and only approximate values are available.

## WALES AND ADJOINING COUNTIES.

*(From our own Correspondent.)*

**Joint Coal Board.**

SINCE the termination of the coal strike miners leaders generally have displayed less aggressiveness and a more reasonable spirit prevails, which rather leads one to hope that the task of setting the industry on its feet so far as human agency on this side is concerned will be accomplished in time without a great amount of discord. Of course, the men's representatives are not without their complaints. One of them is that the national agreement is not being carried out by many of the collieries, and at a recent meeting of the owners' and miners' representatives the latter submitted particulars of the cases where they considered the owners were acting contrary to the terms of the agreement. They urged that the Joint Board provided for in the national agreement should be set up at once so that the machinery might be established for dealing with disputes which might arise from time to time, and they suggested that the Joint Disputes Committee should also be reappointed. Mr. Evan Williams, on behalf of the owners, informed the men that they had every desire and intended to abide by the terms of the national agreement and to work in co-operation with the workmen's representatives in placing the industry on a sound economic basis. The result was that a joint meeting of the two parties was held on Tuesday last for dealing with the establishment of the Joint Board, the settlement of disputes nd the re-employment of workmen. The last question, viz., the re-employment of workmen, is one that affects the coalfield pretty well as a whole, and complaints about workmen not being re-employed are not confined to any particular area. It is computed that so far about 55 per cent. of the men engaged in the coalfield prior to the strike are now at work, but however well-founded may be the allegations of the men's leaders in certain cases that men are not being taken on, it stands to reason that it would have been a unique achievement if within a fortnight of the strike settlement being come to full employment was found for all. It is to be feared that it will be a very long day before this is the case. No doubt steps will be taken to deal promptly with disputes which have kept the miners from re-starting, as in the case of the Ebbw Vale collieries. The strike at the Tirpentwys Colliery, Pontypool, which was responsible for 1600 being idle, came to an end last week. The men resumed on the Thursday, the resolve to do so being come to "in view of the straitened circumstances" of the members affected.

**American Coals.**

No one doubts the wisdom of the action of the Government in taking every possible precaution to safeguard the fuel requirements of consumers in this country at a time when the strike of miners was in progress, but the collapse of the strike and the subsequent arrival in this country of the American coals purchased will result in a material financial loss. A number of cargoes of American coals have come to hand, but many more are on the way or are loading at American ports, the total quantity arranged for being reported in the neighbourhood of about 300,000 tons. Agents who are acting for the Government in the sale of these cargoes are authorised to dispose of the cargoes for any destination, but it is stated that the question of price is not left to their discretion. The coals in question, which are of "run of the mine" or "through" description, are estimated to have cost approximately between 70s. and 75s. per ton delivered at United Kingdom ports, and as it is improbable that the Government will be able to obtain more than 40s. to 45s. per ton, seeing that superior Welsh coal can be bought at 45s. to 50s., the Government stand to lose about 30s. to 35s. per ton. It may even be much higher, as there is by no means a ready demand for the American coal.

**Ship-repairing Outlook.**

As is well known, the ship-repairing industry in South Wales is on a fairly substantial scale, but working costs are a considerable item and are relatively higher than in other districts with which employers have to compete. The decision which has recently been come to between shipowners and underwriters is, therefore, of more than ordinary importance. Hitherto shipowners have decided where and by whom their repairs shall be effected, but the arrangement now come to is that underwriters shall obtain tenders for work to be done and place the orders, and, naturally, they will almost invariably have the job executed at the lowest price put in, irrespective of the source from which it comes. This may be very detrimental to the industry in the Bristol Channel unless employers can obtain conditions which will place them in a position to compete with yards in other areas. South Wales yards have undoubtedly profited largely in obtaining orders by reason of so many of the leading shipowners being associated with dry dock and engineering enterprises, but the new conditions arrived at respecting the placing of orders by the underwriters put a new phase on the situation.

**The Railways Bill.**

The Railways Bill continues to be a lively subject of discussion in this district, each centre being anxious to safeguard its particular interests and welfare. Unfortunately, so far as Cardiff is concerned, division of opinion has been very pronounced between the Corporation, the members of Parliament, and the varying trade organisations, with the result that there has not been unity in directing their forces to secure conditions considered best in the interests of the city. Recently, as the result of efforts made, a larger measure of unanimity between the various parties has been achieved, and it is reported that if the grouping Bill goes through the Cardiff Railway and Docks will go to the Great Western Railway Company on condition that the docks are in an efficient state, the Great Western Company being entitled to deduct from the price the cost of the work of restoration, which is estimated at £1,000,000. It is understood that the work will be carried out without delay, which, if it is the case, will cause no little gratification to the commercial community interested in the coal export trade.

**Leading Colliery Manager.**

The announcement is made that Mr. E. M. Hann, the general manager of the Powell Duffryn Steam Coal Company's collieries, has retired from that position, and that the directors have appointed Mr. Edmund L. Hann, the present assistant general manager, as his successor, while Mr. Douglas Hann, another son of Mr. E. M. Hann, takes the place of assistant general manager. Mr. E. M. Hann, who retires after forty-four years' work in South Wales, is one of the foremost and most expert mining engineers in this district, and the success of the Powell Duffryn Company is very largely due to his efforts and energy. Since he took charge as far back as 1884 the whole of the company's pits have been remodelled and extensive developments have taken place, resulting in an enormous expansion in output. Mr. Hann was president of the South Wales Institute of Engineers in 1903–5, and he is also a past chairman of the Coalowners' Association.

**Current Business.**

During the past few days production at South Wales collieries has appreciably improved, but still the quantity of coal available for export, after meeting the home demand, is readily absorbed, and collieries are well booked up until the middle of next month. The holidays, which will be taken during the first week of August, will place a check upon production, but the probability is that subsequently the miners will settle down to their work and production will increase appreciably, in which event it is fairly certain that values will come down from their present comparatively high level. The inquiry for coal and patent fuel from abroad is quite active, but actual business is not substantial. There is a pretty clear indication that foreign buyers will not continue to pay current prices, which have only been conceded in order to satisfy pressing needs. The inclination so far as future business is concerned is to wait for prices to fall. The question, therefore, arises whether there will be an adequate outlet for Welsh coals should production be largely increased. One thing seems certain, and that is that prices must come down to a more workable level.

# Latest News from the Provinces.

## WALES AND ADJOINING COUNTIES.

**Swansea Metal Exchange.**

A FEW more tin-plate works have re-started but not more than 15 per cent. of the total mills are engaged. Business is very quiet, and doubts are entertained whether any marked improvement will be seen before next year. In some cases quotations for tin-plates for October-December delivery are down to 24s. basis.

**Patent Fuel Workers.**

Although nothing definite has been announced, it is reported that as the result of private conferences the wages of patent fuel workers are to be reduced immediately by 2s. per day, with another 1s. reduction in January.

**Joint Coal Board.**

Coalowners and miners' representatives have definitely agreed to set up a Joint Board, and a Joint Committee is also to be established for dealing with disputes, but the owners' chairman has definitely laid down the principle that disputes could not be dealt with in cases where there had been no resumption of work after the national strike.

**Colliery Development.**

The Powell Duffryn Company, on Monday next, will commence the sinking of twin pits near Bargoed, in the Rhymney Valley. When they are completed work will be provided for over 2000 men. The permanent winding engine and the air compressor have already been installed. The plant is electrically driven from power generated by the company, as in the case of its Britannic colliery at Pengam.

## CATALOGUES.

HAIGHS (OLDHAM), Limited, Globe Ironworks.—List of second-hand and re-built machine tools and woodworking machines which are available for disposal at the present time.

GENERAL ELECTRIC COMPANY, Limited, Magnet House, Kingsway, W.C. 2.—Copy of installation leaflet No. P2453, describing the turbo generating plant supplied to the Newport Corporation east station.

BRITISH ALUMINIUM COMPANY, Limited, 109, Queen Victoria-street, E.C. 4.—Illustrated book No. 170 entitled "Aluminium Facts and Figures." Some seventy pages of closely condensed information is given and many illustrations are included.

HERBERT MORRIS, Limited, Loughborough.—Booklet No. 90 deals with the "Morris" pulley blocks. Many installations of pulley blocks are shown in the illustrations. Leaflet No. 491, which deals with Morris gravity conveyor suitable for carrying boxes, cases, general packages, &c.

CONSOLIDATED PNEUMATIC TOOL COMPANY, Limited, Egyptian House, 170, Piccadilly, W. 1.—Illustrated leaflets dealing with electric grinders which have just been designed by the company for special purposes; also a leaflet dealing with the "Boyer" hammer pick, which is described and illustrated.

HACK SAWS, Limited, Aven Works, Capel-street, Penistone-road, Sheffield.—Illustrated leaflet dealing with the "Aven" bench saw. This bench saw has been devised so that the continual breaking of saws may be prevented. It is claimed that with this device straight and rapid cutting is ensured.

BUTTERS BROTHERS AND CO., Glasgow.—This catalogue is the fifty-first edition of Messrs. Butters' general catalogue dealing with cranes. The different varieties manufactured by the company are illustrated, but these by no means exhaust the number of types they make. Any kind of lifting and hoisting machinery can be supplied, as the works are fitted up with the most up-to-date plant.

SWEDISH GENERAL ELECTRIC, Limited, 5, Chancery-lane, W.C. 2.—Stock list No. 41 deals with direct-current type "K" motors, single-phase motors, direct-current electric drills, type W.J. Stock list No. 41A deals with three-phase and two-phase motors, single-phase commutator motors, transformers, &c. Stock list No. 41F deals with single-phase alternating-current fans, oscillating type.

BROWN BROTHERS, Limited, Great Eastern-street, E.C. 2.—We have received a pamphlet from Messrs. Brown dealing with Kent's glare guard. This glare guard is a piece of blue-tinted glass measuring 5in. by 3in. fitted into a frame, and when attached to the wind screen of the motor car reduces the dazzling glare of brilliant approaching headlights. Four patterns are manufactured for different types of screens.

JOHN I. THORNYCROFT AND CO., Limited, 10, Grosvenor-place, S.W. 1.—This catalogue is issued for the purpose of bringing before the public the Thornycroft passenger motor vehicles. It introduces the "County" model of single-deck omnibus, which is a standardised design especially suitable for transport in the provinces. Particulars are also given of various models of motor coaches which are in demand at the present time.

SIMPLEX CONDUITS, Limited, Garrison-lane, Birmingham.—Illustrated pamphlet, Section J, dealing with the Simplex colliery lighting system. The system comprises a range of flame-proof and water-tight fittings, which have been specially designed and constructed for the attainment of a maximum of efficiency and at the same time the maintenance of a rigid compliance with the latest regulations for the use of electricity in mines.

GWYNNES, Limited, Hammersmith Ironworks, W. 6.—Pamphlet No. 84, dealing with Gwynnes' centrifugal circulating pumping engines. A complete specification of commercial type open and enclosed engines is given, also the specification for Gwynnes' centrifugal split casing circulating pumps. The pamphlet is fully illustrated with pictures and drawings of the machines, and a list of spares for centrifugal circulating pumps is given.

STURTEVANT ENGINEERING COMPANY, Limited, 147, Queen Victoria-street, E.C. 4.—A book has been issued by this company dealing with the modern manufacture of chemical manures. The different machines used in these processes are illustrated and the majority of them are given in section. The reader gets some idea of how the works should be laid down. The illustrations have been carefully prepared and the book is exceptionally well printed.

FROM Mr. A. W. Empson, 39, Victoria-street, S.W. 1, London district agent of Chadburn's Ship Telegraph Company, Limited, we have received a pamphlet dealing with the de Laval method of purifying and reclaiming oils. The de Laval centrifugal oil purifier is more or less a development of the same inventor's well-known cream separator and, in addition to its use on board ship, is now being employed on land for such purposes as purifying, lubricating, cutting, hardening, fuel and crude oils.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—It is proposed, if a sufficient number of candidates makes application, to hold an examination for associate membership of Electrical Engineers in London and at other places, at home and abroad, in October of this year. Entry forms and full particulars may be obtained on application to the secretary of the Institution, Savoy-place, Victoria Embankment, London, W.C. 2.

# Current Prices for Metals and Fuels.

## IRON ORE.

| | |
|---|---|
| N.W. COAST— | |
| Native | 49/- to 60/- |
| [1] Spanish | 30/- |
| [1] N. African | 30/- |
| N.E. COAST— | |
| Native | — |
| Foreign (c.i.f.) | 37/6 |

## PIG IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| SCOTLAND—[2] | | |
| Hematite | 9 0 0 | — |
| No. 1 Foundry | 8 10 0 | — |
| No. 3 ,, | 8 5 0 | — |
| N.E. COAST— | | |
| Hematite Mixed Nos. | 8 0 0 | 7 0 0 |
| No. 1 | 8 2 6 | 7 12 6 |
| Cleveland— | | |
| No. 1 | — | — |
| Silicious Iron | — | — |
| No. 3 G.M.B. | 6 15 0 | 7 0 0 |
| No. 4 Foundry | 6 15 0 | 6 5 0 |
| No. 4 Forge | 5 17 6 | 5 17 6 |
| Mottled | 5 17 6 | 5 17 6 |
| White | 5 15 0 | 5 15 0 |
| MIDLANDS. | | |
| Staffs.— | | |
| All-mine (Cold Blast) | 17 0 0 to 17 7 6 | |
| Part Mine Forge | 8 0 0 | |
| ,, Foundry No. 3 | 9 0 0 to 9 5 0 | |
| Northampton [2]— | | |
| Foundry Nos. 2 and 1 | 8 10 0 | |
| ,, No. 3 | 8 5 0 to 8 10 0 | |
| ,, Forge | 6 17 6 | |
| Derbyshire [2] *(All nominal).*— | | |
| No. 3 Foundry | 8 15 0 to 9 0 0 | |
| Forge | 7 0 0 | |
| Lincolnshire [2]— | | |
| Basic | *Uncertain.* | |
| Foundry | ,, | *—some sold at £8* |
| Forge | ,, | |
| N.W. COAST— | | |
| N. Lancs. and Cum.— | | |
| Hematite Mixed Nos. | 8 0 0 | |
| Special | 9 0 0 to 11 0 0 | |

## MANUFACTURED IRON

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| SCOTLAND— | | |
| Crown Bars | 16 0 0 | 25 0 0 |
| Best ,, | 17 0 0 | — |
| N.E. COAST— | | |
| Crown Bars | 16 0 0 | 19 0 0 |
| Best ,, | 17 0 0 | 20 0 0 |
| Tees | 15 10 0 | 15 10 0 |
| LANCS.— | | |
| Crown Bars | 16 0 0 | — |
| Hoops | 20 5 0 | 20 0 0 |
| S. YORKS.— | | |
| Crown Bars | 16 0 0 | — |
| Best ,, | 17 0 0 | — |
| Hoops | 20 5 0 | — |
| MIDLANDS— | | |
| Marked Bars (Staffs.) | 20 0 0 | — |
| Crown Bars | 16 0 0 | — |
| Nut and Bolt Bars | 16 0 0 | — |
| Black Sheets, (dbls.) | 18 0 0 to 20 0 0 | |
| Galv. Sheets, 24 W.G. (f.o.b. L'pool, or equal | 24 0 0 to 26 0 0 | |
| Gas Tube Strip | 20 0 0 | — |

## STEEL.

| | Home.[5] £ s. d. | Export.[6] £ s. d. |
|---|---|---|
| SCOTLAND—[4] | | |
| Boiler Plates | 20 0 0 | 24 0 0 |
| Ship Plates ⅜in. and up | 15 0 0 | — |
| Sections | 14 10 0 | — |
| Steel Sheets ⅛in. to ⅜in. | 16 5 0 | — |
| Sheets (Gal. Cor. 24 B.G.) | — | 26 0 0 |

## STEEL (*continued*)

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| N.E. COAST— | | |
| Ship Plates | 15 0 0 | 15 0 0 |
| Angles | 14 10 0 | 14 10 0 |
| Boiler Plates | 21 0 0 | 21 0 0 |
| Joists | 14 10 0 | 14 10 0 |
| Heavy Rails | 14 0 0 | — |
| Fish-plates | 19 0 0 | — |
| Channels | 20 0 0 | — |
| Hard Billets | 12 10 0 | — |
| Soft Billets | 11 10 0 | — |
| N.W. COAST— | | |
| BARROW— | | |
| Heavy Rails | 14 0 0 | — |
| Light ,, | 17 0 0 to 19 0 0 | |
| Billets | 13 0 0 | — |
| Ship Plates | 15 0 0 | — |
| Boiler ,, | 21 0 0 | — |
| MANCHESTER *(Prices irregular and uncertain, unchanged)*— | | |
| [7] Bars (Round) | 14 0 0 to 16 0 0 | |
| [7] ,, (others) | 15 0 0 to 16 10 0 | |
| Hoops (Best) | 20 5 0 | 20 0 0 |
| ,, (Soft Steel) | 17 5 0 | 17 0 0 |
| Plates | 15 0 0 | — |
| ,, (Lancs. Boiler) | 21 0 0 | — |
| SHEFFIELD *(Prices irregular and uncertain)*— | | |
| Siemens Acid Billets | 18 0 0 | — |
| Bessemer Billets | 17 10 0 | — |
| Hard Basic | 13 0 0 | — |
| Soft ,, | 12 0 0 | — |
| Hoops | 17 5 0 | — |
| Soft Wire Rods | 13 5 0 | — |
| MIDLANDS— | | |
| Small Rolled Bars | 13 0 0 | — |
| Soft Billets and Bars | 12 0 0 to 13 0 0 | |
| [2] Hoops | 17 0 0 | — |
| Tube Strip | 13 10 0 to 15 0 0 | |
| Angles and Joists | 14 10 0 | — |
| Tees | 15 10 0 | — |
| Bridge and Tank Plates | 15 0 0 | — |

## NON-FERROUS METALS.

| | |
|---|---|
| SWANSEA— | |
| Tin-plates, I.C., 20 by 14 | 24/- to 27/6 |
| Block Tin (cash) | 161 10 0 |
| ,, (three months) | 164 0 0 |
| Copper (cash) | 70 2 6 |
| ,, (three months) | 70 10 0 |
| Spanish Lead (cash) | 23 10 0 |
| ,, (three months) | 23 5 0 |
| Spelter (cash) | 26 0 0 |
| ,, (three months) | 26 15 0 |
| MANCHESTER— | |
| [8] Copper, Best Selected Ingots | 71 10 0 |
| ,, Electrolytic | 75 10 0 |
| [9] ,, Strong Sheets | 105 0 0 |
| ,, Loco Tubes | 0 1 3½ |
| Brass Loco Tubes | 0 1 1½ |
| ,, Condenser | 0 1 5½ |
| Lead, English | 25 0 0 |
| ,, Foreign | 24 0 0 |

(*Metal prices practically unchanged*).

## FERRO ALLOYS,

(*All prices now nominal*).

| | Per Ton. | Per Unit |
|---|---|---|
| Tungsten Metal Powder | 2/- per lb. | |
| Ferro Tungsten | 1/8 per lb. | |
| Ferro Chrome, 4 p.c. to 6 p.c. carbon | £35 | 12/- |
| ,, 6 p.c. to 8 p.c. ,, | £37 | 15/- |
| ,, 8 p.c. to 10 p.c. ,, | £36 10 0 | 15/- |
| ,, Specially Refined | | |
| Max. 2 p.c. carbon | £86 | 32/- |
| ,, 1 p.c. ,, | £96 | 39/- |
| ,, 0·75 p.c. carbon | £120 | 47/- |
| ,, carbon free | 2/9 per lb. | |
| Metallic Chromium | 6/6 per lb. | |
| Ferro Manganese | (per ton) £18 for home. | |
| ,, Silicon, 45 p.c. to 50 p.c. | £15 10 0 scale 8/6 per unit | |
| ,, ,, 75 p.c. | £22, scale 12/- per unit | |
| ,, Vanadium | 22/- per lb. | |
| ,, Molybdenum | 10/- per lb. | |
| ,, Titanium (carbon free) | 1/6 per lb. | |
| Nickel (per ton) | £190 | |
| Cobalt | 15/- per lb. | |
| Aluminium (per ton) | £150 | |

## FUELS [10]

### SCOTLAND.

| | Export. |
|---|---|
| LANARKSHIRE— | |
| (f.o.b. Glasgow)—Steam | 35/6 to 37/- |
| ,, ,, Ell | 37/6 to 38/6 |
| ,, ,, Splint | 40/- to 50/- |
| ,, ,, Trebles | 35/6 |
| ,, ,, Doubles | 33/- |
| ,, ,, Singles | 28/- |
| AYRSHIRE— | |
| (f.o.b. Ports)—Steam | 35/6 |
| ,, ,, Splint | 40/- |
| ,, ,, Trebles | 32/- |
| FIFESHIRE— | |
| (f.o.b. Methil or Burntisland)—Steam | 35/- to 40/- |
| Screened Navigation | 50/- |
| Trebles | 36/6 |
| Doubles | 32/- |
| Singles | 29/- |
| LOTHIANS— | |
| (f.o.b. Leith)—Best Steam | 38/- |
| Secondary Steam | 34/6 |
| Trebles | 32/- |
| Doubles | 30/- |
| Singles | 27/- |

### ENGLAND.

| | |
|---|---|
| [10] N.W. COAST— | |
| Steams | 45/- to 49/- |
| Household | 56/8 to 60/- |
| Coke | 56/- |
| NORTHUMBERLAND— | |
| Best Steams | 43/- to 45/- |
| Second Steams | 40/- to 41/- |
| Steam Smalls | 13/- to 17/6 |
| Unscreened | 30/- to 35/- |
| Household | 36/- to 40/- |
| DURHAM— | |
| Best Gas | 40/- to 42/6 |
| Second | 35/- to 37/6 |
| Household | 36/- to 40/- |
| Foundry Coke | 55/- to 60/- |
| SHEFFIELD— [11] | |
| S. Yorks. Best Steam Hards | 33/2 to 33/8 |
| Derbyshire Hards | 32/8 to 33/2 |
| Seconds | 31/8 to 32/2 |
| Cobbles | 31/8 to 32/2 |
| Nuts | 31/2 to 32/2 |
| Washed Smalls | 28/8 to 30/2 |
| Best Hard Slacks | 20/- to 25/- |
| Seconds ,, | 20/- to 23/- |
| Soft Nutty ,, | 20/- to 25/- |
| Pea ,, | 18/- to 22/- |
| Small ,, | 15/- to 18/- |
| House, Branch | 40/2 to 40/8 |
| ,, Best Silkstone | 36/8 to 37/2 |
| Blast Furnace Coke | (45/-, 55/- export) |

### SOUTH WALES. [12]

| | |
|---|---|
| CARDIFF— | |
| Steam Coals: | |
| Best Smokeless Large | 47/6 to 50/- |
| Second ,, ,, | 45/- to 47 6 |
| Best Dry Large | 45/- to 47/6 |
| Ordinary Dry Large | 42/6 to 45/- |
| Best Black Vein Large | 47/6 to 50/- |
| Western Valley ,, | 45/- to 47 6 |
| Best Eastern Valley Large | 45/- to 47 6 |
| Ordinary ,, ,, | 40,- to 45/- |
| Best Steam Smalls | 25/- to 30/- |
| Ordinary ,, | 17/6 to 22/6 |
| Washed Nuts | 42 6 to 47 6 |
| No. 3 Rhondda Large | 47/6 to 50,- |
| ,, ,, Smalls | 35'- to 40/- |
| No. 2 ,, Large | 40/- to 42 6 |
| ,, ,, Through | 35/- to 37/6 |
| ,, ,, Smalls | 17 6 to 22 6 |
| Coke (export) | 55'- to 60/- |
| Patent Fuel | 45,- to 47,6 |
| Pitwood (ex ship) | 37,6 to 40/- |
| SWANSEA— | |
| Anthracite Coals: | |
| Best Large | 60/- to 62/6 |
| Seconds | 55/- to 57/6 |
| Red Vein | 55/- to 57/6 |
| Big Vein | 55/- to 57,6 |
| Machine-made Cobbles | 67/6 to 72/6 |
| Nuts | 67/6 to 72/6 |
| Beans | 57/6 to 62/6 |
| Peas | 42/6 to 47/6 |
| Breaker Duff | 15/- to 17/6 |
| Rubbly Culm | 22/6 to 25/- |
| Steam Coals: | |
| Large | 47/6 to 50/- |
| Seconds | 40/- to 45/- |
| Smalls | 17/6 to 22/6 |
| Cargo Through | 37/6 to 40/- |

[1] Delivered. [2] Not Makers' works. [3] At furnaces. [4] Glasgow, Lanarkshire and Ayrshire. [5] Home Prices—All delivered Glasgow Station.
[6] Export Prices—F.O.B. Glasgow. [7] Prices represent the real market before the *official* change was made. [8] These prices are practically alike now.
[9] Sheets reduced while other prices are advancing. [10] Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. [11] For inland sales. [12] Per ton f.o.b.

# French Engineering Notes.

*(From our Correspondent in Paris.)*

**Trade and Tariffs.**

THE uncertain position created by the tariff war is partly, though by no means wholly, responsible for the instability of business, and is causing great uneasiness amongst manufacturers, who see that their efforts at developing foreign trade are compromised by the tariffs which other countries are putting up against imported goods. On the whole, it might be thought that French makers would be in a particularly satisfactory position on account of the considerable amount of work that must be put in hand at some time or another, and in the event of the reconstruction loans being covered there is no doubt that a good many orders will be distributed at an early date. For the moment, however, work is so scarce that there are very few factories running full time. In every direction markets are being restricted by the putting up of import duties, and there is a good deal of irritation over the inquisitorial procedure of the American customs authorities, which claim the right to verify the prime cost of goods exported to the United States. The American customs urge that makers have every interest in facilitating this inquiry, but it opens up a new phase of fiscal inquisition which French manufacturers declare is likely to prove very unfair to themselves. If the French are complaining of the high duties imposed by other countries, they are meeting with recrimination on account of their own increased tariff, especially from Belgium, where the opposition has taken the form of a public protest on the ground that a country bound by a military alliance to France deserves more consideration as regards commercial facilities than is being meted out to it. Moreover, it is argued that the goods imported from Belgium do not compete directly with French industries. The fact remains that the tendency at the moment is distinctly in the direction of a tariff war, and that is strongly objected to by the great majority of the commercial classes.

**Wages Reductions.**

Obviously, the only way to develop business is to bring down manufacturing costs. The chief factors in the excessive cost of manufacture were the dearness of fuel and the high wages, and while coal and cokes have come down considerably in price, with a consequent reduction in the values of raw materials, there has not been a corresponding decline in wages, with the result that, despite the more favourable economical conditions, the prices of manufactured goods are still regarded as too high. It is understood that some of the railway companies would be quite disposed to give out contracts for rolling stock if only they could get more favourable terms. For some time, therefore, efforts have been made to reduce wages, apparently with a certain measure of success, since in different parts of the country wages in the engineering trades have undergone reductions varying from 10 to 20 per cent. These reductions, however, do not represent any actual cut in wages, but are simply a partial suppression of the indemnity that was added to the wages to compensate for the higher cost of living, and now that the prices of commodities have fallen the men were bound to relinquish a part of the indemnity, especially when they saw that any refusal to accept the reduction would have the effect of swelling the ranks of unemployed. The wages paid are still above the guaranteed minimum, and in view of the precarious state of the industry manufacturers are trying to convince the men that they must make further sacrifices if the factories are to be kept in operation. The men's unions, which stood aloof so long as the indemnities were being suppressed, are now agitating strongly against any cut in wages, and in the Nord there is a threatened strike in the metallurgical industries, while in the textile trades the operatives have already left work, despite the fact that for a long while past manufacturers have kept the factories running on stock simply to provide the men with employment. Resistance is so obviously out of the question in the present state of business that the men cannot afford to persist in the strike movement, which would only give manufacturers an excuse for closing down works until the situation improved. Apart from the question of wages, manufacturers are investigating every possible means of bringing down prime costs so as to be in a position to compete for the world's trade, and it is hoped that much will be done in that direction with the aid of co-operation in the different branches of industry for facilitating the introduction of the most economical methods of manufacture. An important factor in the reduction of working costs is expected to be the development of hydro-electrical installations, which, in many cases, have already given encouraging results.

**Machine Tools.**

The stagnation of the machine tool trade would appear inexplicable in view of the heavy demands for reconstruction in the devastated regions, but the situation is explained by the fact that there are still considerable stocks of machines that will have to be absorbed before there can be any recrudescence of buying abroad. Before the war France imported close upon 23,000 tons of machines a year, one-half being supplied by Germany and the remainder by Britain, the United States, and Belgium. The exports from France amounted to 6200 tons. The production of machine tools in France during that period was about 16,000 tons, so that the home consumption was about 32,800 tons. During the first three years of the war France only imported about 42,000 tons of machine tools, mostly of special types for munition work, but after the Armistice she received 33,000 tons in 1919 and 56,000 tons in 1920, the latter total including 13,000 tons restituted by Germany. At the same time, the home production of machine tools has increased to 20,000 tons a year, so that taking into account the imports and the home production, less the exports, the consumption in 1919 reached 50,100 tons and in 1920 amounted to 56,700 tons, which means that a considerable quantity must have gone into stock. To this must be added the huge quantities of British and American machine tools disposed of as war stocks. This heavy accumulation will probably act as a load on the market for quite a long time.

# British Patent Specifications.

*When an invention is communicated from abroad the name and address of the communicator are printed in italics.*

*When an abridgment is not illustrated the Specification is without drawings.*

*Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.*

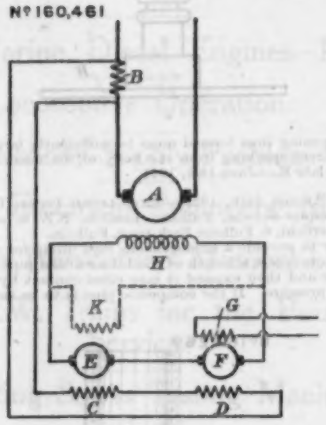
*The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.*

## DYNAMOS AND MOTORS.

160,461. February 28th, 1921.—AN IMPROVED METHOD AND APPARATUS FOR COMPOUNDING DIRECT-CURRENT MOTORS, Brown, Boveric et Cie., of Baden, Switzerland.

This specification describes a new system of compounding an electric motor so that the machine shall have, within the range of small loads, an almost constant excitation which, however, will increase rapidly from a determined load and upwards. The connections for the system are shown in the accompanying drawing. A is the direct-current motor, B a resistance, E and F are

N° 160,461



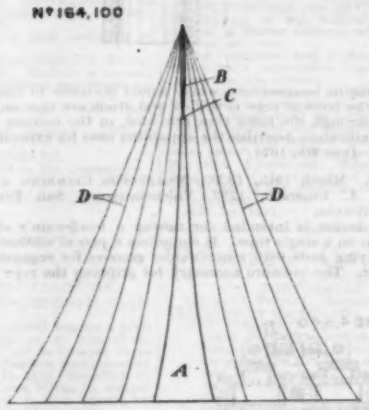

two series-connected exciting machines supplying current to the exciting winding H of the direct-current motor. C and D are the series-connected exciting windings of the machines E and F, and these windings are connected in parallel to the resistance B. G is a separate excitation winding for F, and K is an exciting winding of the machine E. The principle upon which the system operates is described.—*June 16th*, 1921.

## WIRELESS TELEGRAPHY.

164,100. February 27th, 1920.—IMPROVEMENTS IN THE CONSTRUCTION OF AERIAL MASTS FOR WIRELESS TELEGRAPHY AND THE LIKE, Steffen Moehl, of 40, Inverness-terrace, London, W. 2.

A mast constructed in accordance with this invention is shown in the drawing. The main part is a self-supporting tower A of great height, constructed of reinforced concrete, steel or other materials. On or near its top this tower carries the second part

N° 164,100



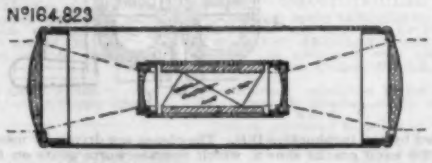

consisting of a slender mast or column B, which is called the pendulum. The lower end of the pendulum B is supported by a universal joint C. The pendulum is further supported, at its top or a little below, by guys D anchored in the ground.—*May 27th*, 1921.

## MEASURING AND TESTING INSTRUMENTS.

164,823. March 10th, 1920.—POLARISING LIGHT, E. G. Coker, 3, Farnley-road, Chingford, Essex, and A. L. Kimball, jun., 2, Bedford-place, London, W.C. 2.

In order to economise as much as possible in the amount of

N° 164,823

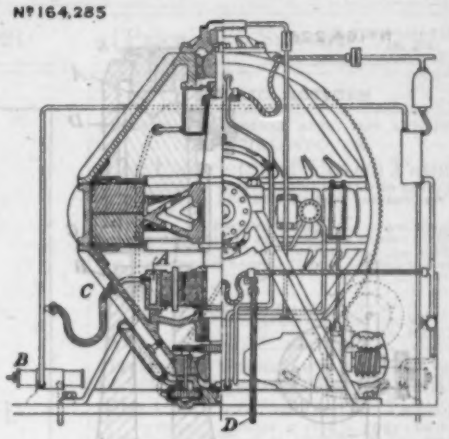


Iceland spar—an expensive material—necessary in polarising a large beam of light, a parallel beam of light, from a suitable source, is rendered convergent by a suitable lens or system of lenses, and at a place in this convergent beam where the pencil of rays has a suitably reduced cross section another lens or system of lenses is interposed to restore parallelism either wholly or partially so as to enable this much smaller beam to pass through the polarising prism or its equivalent. On emergence, an arrangement of lenses is used which expands this polarised beam to a suitable size for use either as a parallel or divergent pencil of rays.—*June 10th*, 1921.

164,285. July 24th, 1919.—GYROSCOPES, *P. R. Jackson*, 35, *Lyncroft-gardens, London, N.W. 6.*

In this specification a claim is made for a system of water cooling the motor of a gyroscope which rotates in an evacuated

N° 164,285



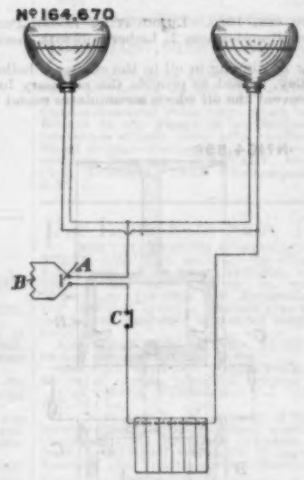

casing. The stator of the motor is provided with an annular channel A to which water is supplied by means of the pump B and connection C. The outlet for the water is shown at D.—*June 9th*, 1921.

## MOTOR CARS AND ROAD TRAFFIC.

164,670. November 20th, 1920.—IMPROVEMENTS IN ELECTRIC LIGHTING SYSTEMS FOR MOTOR VEHICLES, The Daimler Company, Limited, and Algernon Edward Berriman, both of Daimler Works, Sandy-lane, Coventry.

This invention relates to electric lighting systems for motor vehicles. A switch in the lighting circuit connects a resistance in one of the battery leads for the purpose of dimming the lights

N° 164,670



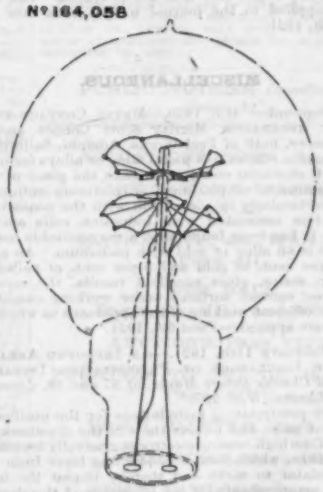

momentarily, thereby avoiding danger and discomfort to the drivers of oncoming vehicles. The switch is shown at A and the resistance at B. A main switch is also connected at C.—*June 16th*, 1921.

## LIGHTING AND HEATING.

164,058. December 18th, 1919.—IMPROVEMENTS IN INCANDESCENT ELECTRIC LAMPS, Leon Alexander, of The Limes, The Avenue, St. Margarets-on-Thames.

The filament of the electric lamp described in this specifica-

N° 164,058



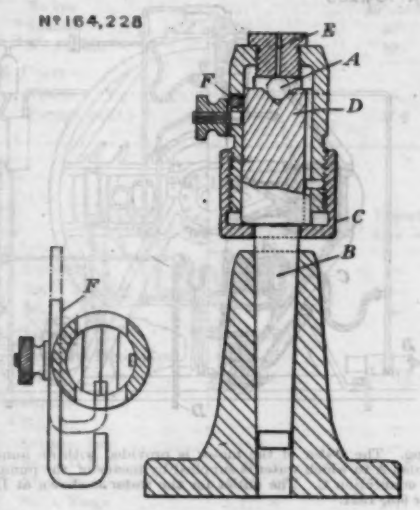
tion is designed with a view to minimising the risk of failure The filament is divided into two or more sections, which are arranged in parallel with one another so that if a wire forming

one part of the filament breaks the lamp will not be rendered useless, because the current will still be able to pass through the other section.—*May 18th*, 1921.

## MACHINE TOOLS AND SHOP APPLIANCES.

164,228. May 21st, 1920.—A DRILLING JIG, D. W. Wildy, sen., and D. W. Wildy, jun., 119, Studley Grange-road, Hanwell, Middlesex.

This is a little jig, or fixture, for drilling cotter pin holes in bars.

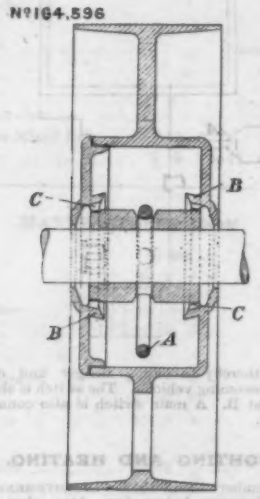



The work A is placed in a V notch in the top of the stem B and is held down by the nut C being screwed up on to the sleeve D. The sleeve has windows cut in the sides for the passage of the work. Interchangeable bushes E are provided for guiding the drill, and a gauge F arranged to determine the position of the hole with respect to the end of the bar.—*June 9th*, 1921.

## TRANSMISSION OF POWER.

164,596. May 6th, 1920.—LUBRICATING LOOSE PULLEYS, C. Dullmann, Hauptstrasse 2, Liebertwolkwitz, near Leipzig, Germany.

The oil ring A, dipping in oil in the enlarged, hollow boss of this loose pulley, is said to provide the necessary lubrication. In order to prevent the oil which accumulates round the inside




periphery of the boss when the pulley is rotating from spilling out of the shaft holes as it trickles down the sides, on the pulley stopping, sharp-edged ribs B B are provided. The holes C C allow oil supplied to the journal to run back into the boss.—*June 16th*, 1921.

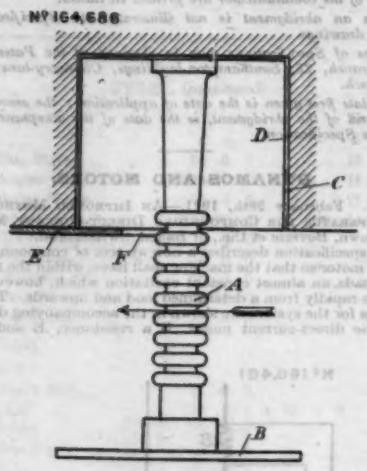
## MISCELLANEOUS.

164,142. September 4th, 1920.—METAL CONTACT FOR ELECTRICAL APPARATUS, Merritt Scott Conner and Samuel Lyttlemore, both of Peel Works, Adelphi, Salford.

This invention relates to a metal alloy or alloys for use in connection with electrical contacts to take the place of the more expensive contacts of platinum or platinum-iridium usually employed particularly in connection with the contact breakers or interrupters associated with induction coils and ignition magnetos. It has been found that a very suitable material for the purpose is an alloy of gold with palladium. An alloy comprising 91 per cent. of gold and 9 per cent. of palladium, the specification states, gives excellent results, the metal giving durably clean contact surfaces under working conditions and ensuring the efficient working of the apparatus to which the contact pieces are applied.—*June 6th*, 1921.

164,636. February 11th, 1921.—AN IMPROVED ARRANGEMENT OF THE INSULATORS OF PRECIPITATING INSTALLATIONS, *Edward Charles Robert Marks, of 57 and 58, Lincoln's Inn-fields, London, W.C. 2.*

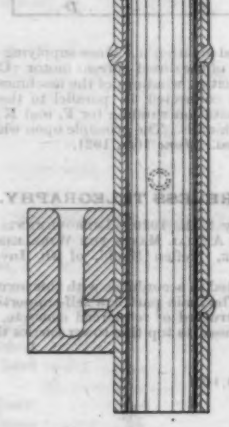
In electric precipitating installations for the purification and separation of gases and liquids there is the drawback that the insulators of the high-tension electrodes gradually become covered with impurities, which form a conducting layer from the high-tension insulator to earth and thereby impair the insulation. The known arrangements for the avoidance of this drawback, in which the insulator is fixed in a recess, act only imperfectly. According to this invention the insulator A supports the high-tension electrode B. The foot of the insulator is fixed within the recess C. The recess is provided with a conducting layer D, with, for instance, a lead lining. The left-hand side of the drawing shows a further metal sheet E at the edge of the recess, and this metal sheet partially closes the opening of the recess and leaves only an opening F for the insulator to pass through. The




annular opening thus formed must be sufficiently large for preventing direct sparking from the body of the insulator to the covering plate E.—*June 16th*, 1921.

164,269. August 24th, 1920.—LEAD-LINED PIPES, T. Harden, 18, Napier-avenue, Fulham, London, S.W. 6, and N. A. Chesterfield, 6, Fulham Park-road, Fulham.

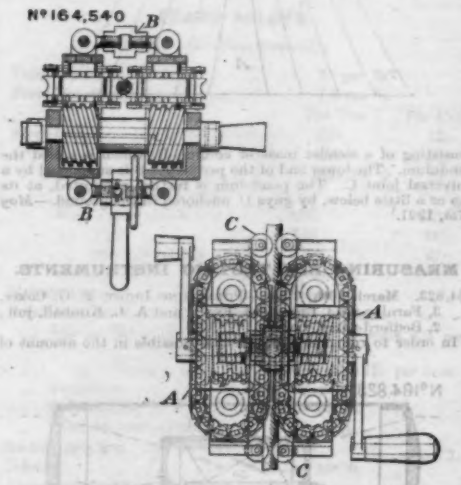
In order to provide a homogeneous lead lining for steel pipes the inventors insert a length of solid-drawn lead pipe inside the other pipe and then expand it into close contact by means of hydraulic pressure. If the composite pipe is to be subjected to




variations in temperature, which would be liable to loosen the lining, the outside pipe is drilled and studs are cast on to the lining, through the holes thus provided, in the manner shown. The specification describes the apparatus used for expanding the lining.—*June 9th*, 1921.

164,540. March 19th, 1920.—MEANS FOR CLIMBING A ROPE, G. A. Emerson, 1282, Valencia-street, San Francisco, California.

This device is intended for raising a boatswain's chair or platform on a single rope. It comprises a pair of endless chains A A, having pads with semi-circular grooves for engaging with the rope. The pressure necessary for gripping the rope is pro-




vided by the turnbuckles B B. The chains are driven by means of the hand cranks shown, which operate worm gears on the lower chain sprockets. Guide wheels C C are provided to lead the rope to the chain pads.—*June 16th*, 1921.

## LAUNCHES AND TRIAL TRIPS.

RAYLIGHT; built by J. Samuel White and Co., Limited, to the order of Ross and Marshall, of Greenock; dimensions, 187ft. by 29ft. 3in. by 13ft. 6in.; to carry, 800 tons deadweight. Engines, triple-expansion, 15in., 25½in. and 41in. by 30in. stroke, pressure 180 lb. per square inch; constructed by the builders. Trial trip, Saturday, July 2nd.

ROCOTT; motor tug; built by Jas. Pollock, Sons, and Co., Limited, to the order of A. G. Humphrey and Henry Grey, jun.; dimensions, 75ft. by 16ft. 3in. by 8ft. 8in. Engines, 350 brake horse-power four-cylinder model "N.E. 11" direct reversible heavy marine type; constructed by the builders; launch, Thursday, July 7th.

A. B. CONAN; twin-screw ferry steamer; built by Palmer's Shipbuilding and Iron Company, Limited, to the order of Corporation of Jarrow; dimensions, 97ft. by 38ft. by 10ft. 1½in.; to carry 655 passengers. Engines, twin-screw triple-expansion; constructed by the builders; trial trip, Friday, July 8th.

AL OSO; built by Sir W. G. Armstrong, Whitworth and Co., Limited, to the order of Lobitos Oilfields, Limited; dimensions, 448ft. by 57ft. 2in. by 33ft. 11in.; to carry 16,175 tons. Engines, triple-expansion marine type, 29in., 46in. and 81in., by 54in. stroke, pressure 180 lb.; constructed by the builders; launch, Thursday, July 7th.

MONTE VISO; steel screw steamer; built by Sir Raylton Dixon and Co., Limited, to the order of La Société Générale de Transports Maritimes à Vapeur; dimensions, 370ft. by 53ft. by 28ft. 6in.; to carry 7800 tons deadweight. Engines, triple-expansion, 25in., 41in. and 68in. by 45in. stroke, pressure 180 lb.; constructed by Richardsons, Westgarth and Co., Limited; trial trip, Wednesday, July 6th, speed of over 11 knots attained.

## PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. FRANK H. BULLOCK has been appointed assistant engineer to the waterworks engineer of Cardiff.

MESSRS. THOMAS SHANKS AND CO., of Johnstone, ask us to announce that their works will be closed for the midsummer holidays from Friday evening, July 29th, 1921, till Tuesday morning, August 16th. No goods will be received between those dates, and only urgent correspondence will be dealt with.

WE are asked to state that on and after the 25th instant Messrs. Vernon Proctor and Co., of Foster's Buildings, 22, High-street, Sheffield, are taking over the agency for the Galco cold heading, thread rolling and screw making machines, &c., manufactured by the Bofors Company of Sweden, and that in future all communications regarding those machines should be addressed to them.

THE ASSOCIATION OF CONSULTING ENGINEERS (INCORPORATED).—At the last meeting of the Committee of the Association of Consulting Engineers, Mr. W. Vaux Graham, of 5, Queen Anne's-gate, Westminster, S.W. 1, was unanimously elected chairman for the ensuing year.

BRITISH CATALOGUES FOR RIGA.—In connection with the catalogue and sample room recently established at the British Consulate at Riga, the British Vice-Consul reports that while numbers of trade catalogues and samples have been received, the collection is not sufficiently comprehensive to meet local requirements, and that he would therefore be glad to receive additions to it. Catalogues dealing with machinery and accessories for asbestos manufacture are particularly required. The Vice-Consul points out the advantage which will ultimately accrue from this method of advertising, even though there is no immediate demand for the particular article dealt with. The catalogues or other trade literature should preferably be in Russian or German. As there is at present no parcel post in Riga, the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1, is endeavouring to arrange for the collection and dispatch in bulk of catalogues and small samples, but it is particularly requested that no matter for dispatch under such arrangements be forwarded to the Department at present.

FOREIGN EXCHANGES AND THEIR INFLUENCE ON INDUSTRY.—A conference of employers and trade union representatives is to take place this week-end at the residence of Sir Samuel Waring, Footscray, Kent, at which the subject to be considered is "Foreign Exchanges and their Influence on Industry." The gathering is one of the series of week-end conferences which have been arranged under the auspices of the Industrial League and Council, and which, through the generosity of prominent personages in the commercial and industrial world, are being held at their country residences. The conference is to be opened by Mr. H. G. Williams, A.M.Inst. C.E., and among the people who will be present are:—Mr. E. J. P. Benn (Messrs. Benn Bros.), Mr. A. Bellamy (National Union of Railwaymen), Mr. A. Dalgleish (Workers' Union), Mr. A. Dumas (British Thomson-Houston Company), Mr. H. H. Elvin (general secretary, National Union of Clerks), Mr. E. J. Garmeson (Lloyds Bank, Limited), Mr. Jabez Hall (Iron and Steel Trades Confederation), Mr. Hugo Hirst (General Electric Company), Mr. S. E. Jackson (National Union of Railwaymen), Mr. J. W. H. Juddery (Messrs. Juddery and Co.), Mr. R. Sim (National Foremen's Association), Lieut.-Colonel E. Lawson, the Right Hon. G. H. Roberts, Mr. E. Wharton (assistant general manager, London and North-Western Railway), Mr. H. Williams (Machine Tool Trades Association), Mr. H. T. Young (Messrs. Troughton and Young), and Mr. John Ames (general secretary, Industrial League and Council).

LONDON "TOLL" EXCHANGE.—The Postmaster-General announces that in order to relieve the pressure on the London Trunk Exchange, a new telephone exchange is in course of erection and is expected to be opened towards the end of the summer. The new exchange will be situated near Fleet-street, and will be known as the London Toll Exchange. It is of an entirely new type, and has been designed so that the telephone traffic between London and the nearer provincial towns may be handled with greater dispatch. At the date of opening, the trunk lines between London and provincial towns which are within a distance of approximately 25 miles radius from the City will be transferred to the Toll Exchange from the London Trunk Exchange. The area served by the new exchange will contain about 300 exchanges and rural call offices, and will include the following towns:—Aylesbury, Luton, Dunstable, St. Albans, Watford, Brentwood, Dorking, Leatherhead, Woking, Weybridge, Hertford, Ware, Maidenhead, Uxbridge, and Sevenoaks. Additional trunk lines are being provided and other measures adopted so that subscribers may be enabled to effect calls with as little delay as possible. When it is desired to put a call through to any of the towns which are included in the Toll area the public will ask for "Toll" instead of "Trunks," as at present. The local exchange will then connect the caller to the Toll exchange, where the operator will have access to all the trunk lines, or toll lines, which are connected to that exchange. If all the lines to a particular town are engaged, the telephonist will record the details of the call and ring the subscriber as soon as a connection can be given. Full details of the new service will be published in the Press, and an explanatory circular sent to each subscriber in the London Telephone Area in a few weeks' time.